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CZECHO-SLOVAKIA — THE BRIDGE BETWEEN EAST AND WEST[1]

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Recently the attention of the world was focused on Czecho-Slovakia because of the communist *coup d'etat* there and she still is in the news. Most people know very little about Czecho-Slovakia and therefore draw wrong conclusions. Having lived there for 25 years I feel able to discuss the geopolitical, economic, cultural, and military implications of the communist *coup d'etat* in Czecho-Slovakia in a more competent way.

1. THE GEOPOLITICAL IMPLICATIONS

Czecho-Slovakia, about 600 miles long and 100 miles wide, lies in the heart of Europe bordered by Germany in the west, Russia in the east, Poland in the north and Austria and Hungary in the south. A rather precarious position. The *coup d etat* means a consolidation of the Pan-Slavistic space and a further advance of the Russian sphere of influence towards the West. Russia's one party system was copied when the Social-Democratic Party was absorbed by the Communist Party and the entire government adopted a single list of candidates for the May elections. Dr. Benes resigned in June. Com. Gottwald took over the presidency.

Czecho-Slovakia is somewhat larger than Ohio (Cz. area 49,358 square miles, Ohio's 41,222 square miles), but her population is more than twice as large (Cz. population 14,447,000, Ohio's 6,907,612). This discrepancy is another basic reason for the Czech. troubles. In addition there are two extensive mountain systems: the Carpathian in the eastern part of Moravia, Slovakia and Carpathian Russinia and the Sudeten in the western parts of Moravia, Bohemia and Silesia; leaving only about 35% of the country's area for farming. But intensive agriculture still is the predominant occupation claiming about 40% of the population, especially in the east. Wheat, rye, barley, oats, potatoes, sugar beets, corn and hops are grown in abundance. After World War I the number of peasants was greatly increased by the sequestration of all large estates formerly owned by the Austrian aristocracy and by the land reform for the benefit of Czech. legionnaires. This trend continued after World War II after the expulsion of the Sudeten Germans and now is in full swing with regard to all other estates and foreign-owned land. Only small-scale farms up to 120 acres a family, are permitted to remain in private hands. This land reform may be politically expedient, but it is not economically sound because it means a split-up of well established argicultural units and higher operational expenses to the new units.

Czech. mineral wealth is great and comprises both soft and hard coal, iron, graphite, garnets, uranium, silver, copper, lead, and rock salt. On October 24,

[1]Paper presented before the Geography Section of the Ohio Academy of Science at the annual meeting held at the University of Toledo on May 7, 1948.

1945, all mines were nationalized and now they are called "national enterprises" (narodni podniky).

The famous subterranean caverns, lakes, ice caves, labyrinths, etc., as well as the Czech. pass and mineral springs used to attract many American, British, French, etc., tourists who may prefer to stay home now.

2. The Economic Implications

Minister of Industry, Fierlinger, estimated last month that under the nationalization decrees already legalized by the Czech. Parliament, 90% of Czechoslovak industry is in the hands of the state. The law provides for state ownership of all export and import, commercial banks, insurance companies, public utilities, defense industries, steel plants, the Bata shoe factories, manufacturing concerns of drugs and phonograph records, glass and chemical industries, paper industries, spinning and weaving mills, clothing factories, hotels, wholesale trade, printing establishments (except small outfits not using rotary presses or similar equipment) and of every other establishment employing more than 50 persons. It means that the great majority of Czechs and Slovaks not on farms will have to work for the state or state enterprises. At the same time, the government inaugurated a large-scale program designed both to reorganize industrial units into more effective combinations and to concentrate production in the most technically competent areas.[2]

To wipe out deficits of the nationalized industries the government adopted October 28, 1946, a Two-Year Plan. The overall goal is to raise production of both capital and consumer goods 10% above 1938 by the end of 1948. To this end the government is spending $1,397,000,000 in all phases of Czechoslovak economy.[3]

This planned industrialization of Czecho-Slovakia is closely linked to a similar planning in Poland. In July, 1947, the two countries signed a five-year trade treaty. This treaty provides for extensive development of communications and transport between the two countries and "regulated relations" between their respective industrial and agricultural systems. A bilateral Council of Economic Collaboration was set up and trade exchanges planned for the period July 1, 1947, to July 30, 1948.[4]

The only effect the communist *coup d'etat* has on foreign trade is the complete nationalization of all foreign trade.[5]

The Czecho-Slovak economy is dependent on foreign trade both as an outlet for the products of industry and for supplies of raw materials. Before the war 75% of exports were finished goods and more than 50% of imports were raw materials. Postwar trade is following a similar pattern.

By value the principal imports are raw cotton, wool, iron and other metallic ores, mineral oils, and chemicals. Principal exports are iron and steel products, machinery, textiles, glass, timber, pulp, and paper.

Principal imports from the United States before World War II were cotton, fruits and nuts, machinery, copper, and petroleum. Principal exports to the United States were textile fabrics and products, leather wares, glass and glassware, malt and hops, and wood pulp.

Total trade during 1946 amounted to about 24.5 billion crowns (490 million dollars), of which imports totaled 10.2 billion crowns (204 million dollars) and exports totaled 14.3 billion crowns (286 million dollars). The trade picture with the United States is very dark—in 1947 there was a deficit of imports over exports of 1.9 billion crowns (38 million dollars). Russia's challenge to the United States,

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[2]Foreign Policy Reports, (April 1, 1948), Vol. 24, p. 19.

[3]Current History, (November, 1947), Vol. 13, p. 272.

[4]Foreign Policy Reports, (April 1, 1948), Vol. 24, p. 20.

[5]New York Times, (March 7, 1948), Gregor Speech, p. 10.

Great Britain, etc., is that of a country which, because of its boundless need for all kinds of products after the wartime destruction suffered, offers a huge market for the exports of other nations. In this respect, Russia has and may continue to have a greater power of attraction for the countries of Central and Eastern Europe and the Balkans than the United States, which has been more concerned in increasing its own exports than in encouraging imports from actual or potential customers. Like other countries of Central and Eastern Europe, Czecho-Slovakia has conducted its foreign trade since World War II mainly on the basis of short-term bilateral barter agreements subject to renewal. By April, 1948, Czecho-Slovakia had such agreements with 25 countries in the East and West, but had not yet completed a trade agreement with the United States. Despite its present dependence on bilateral agreements, Czecho-Slovakia has constantly professed a desire ultimately to return to a system of multilateral trade proposed by the United States, once conditions are favorable to such a development. She has participated in the European Economic Commission as well as in the negotiations for the Trade and Tariff Agreement of October 31, 1947, and signed the Charter of the International Trade Organization on April 2, 1948, i.e., after the communist *coup d'etat*. Russia did not sign it. In May, 1948, the U. S. granted Czecho-Slovakia the tariff concessions in accordance with the agreement of October 31, 1947.

The official rate of the Czech. crown is 50 crowns to one U. S. dollar. Recently the black market rate rose from 150 to 340 crowns to the dollar. This development indicates less confidence in the Czech. crowns and a considerable increase in the desire for U. S. dollars.

3. The Cultural Implications

The Czech. government is pledged to maintain "practical" cultural relations with the Soviet Union. The Czech. Minister of Education is a communist. He removed Rector Karel Englis, internationally famed economist and ex-minister of finance, from the presidency of the Charles University of Prague—now 600 years old—and Bohumil Bydzovsky, leftist mathematician, is rector of the university of Prague now. Since the Communist coup, "action committees" have taken control of the university. More than 200 students have been expelled, though 25 U. S. students still study there (the 22 who are veterans have been cut off G.I. Bill of Rights benefits). Before they take final exams, all students will have to qualify for "certificates of national and political reliability."[6] All these things have not changed the University of Prague nor Bohemia as places of Western culture. People use Western expressions. Many streets and squares are named after American presidents. It was not possible for the Hapsburgs and Hitler to digest Czecho-Slovakia; it will not be possible for Stalin to enslave the Czech. people.

4. The Military Implications

The military potential of the Russian sphere of influence was strengthened by the Communist *coup d'etat* in Czecho-Slovakia, because the cities Prague, Stara Boleslav, Lazne Belohrad, Benesov u Prahy, Boskovice, Brno, Ceske Budejovice, Nemecky Brod, Frenstat, Mistek, Hodonin, Velke Mezerici, Humpolec, Vysoke Myto, Hostivice, Jihlava, Jaromer, Jinec, Jicin, Josefov, Mlada Boleslav, Hrebeny, Kladno, Klatovy, Hradec Kralove, Kolin, Kralupy, Louny, Lobnik, Moravska Ostrava, Hranice, Milovice, Jindrichuv Hradec, Nove Mesto n. Mor. Olomouc, Pardubice, Pribramy, Pelhrimov, Plzen, Pisek, Prelouc, Prerov, Prostejov, Psikosice, Rakovnik, Slany, Susice, Sedlcany, Strasice, Tabor, Domazlice, Telc, Trebic, Vyskow, Vsetin, etc., have training areas and other

[6]Time, April 19, 1948, p. 23.

military installations. Czecho-Slovakia has eleven ammunition factories, including the famous Skoda Works, twelve transmitters and 8,262 miles of rails, all of it hardly damaged in World War II. The Czech. Army has 160,000 men—Russia allotted $152,000,000 for it in her last budget. Universal military service for all men between 20 and 50 years of age was re-established in 1940 with service for two years. Hitler turned the Army into a labor corps, but now it is re-established. Czecho-Slovakia signed several military assistance pacts with her neighbors, the last one with Bulgaria. It is primarily because of Czecho-Slovakia's fear of a restored strong Germany that the Soviet alliance is regarded by all existing parties as the proper foundation of the nation's military policy.

Conclusions

Czecho-Slovakia has to maintain military, political, economic and cultural relations with the Soviet Union. Her dependence on Russia for her economic and military security, however, does not exclude agreements with countries outside the Soviet sphere. Czecho-Slovakia signed the Trade and Tariff Agreement of October 31, 1947, and the Charter of the International Trade Organization on April 2, 1948, after the Communist coup although Russia did not sign them.

Czecho-Slovakia should remain the bridge that connects East with West and not become the bridge which could be used by the troops of both for mutual destruction.

Ecology and Linkage versus Gene Infiltration

Every breeder, amateur or scientist, who ever attempted to shift the desirable characters of one kind of plant or animal over into another kind of plant or animal had to practise introgressive hybridization. Introgression was originally defined as the gradual infiltration of the germplasm of one species into that of another species. As a phenomenon, however, introgression may occur across any taxonomic boundary so long as hybridization followed by repeated backcrossing is possible. Thus introgression occurs in nature as well as the breeder's experiments. It has therefore played a role in evolution, unevaluated as yet, by enriching the genetic variability of the participating entities. The effects of genteic linkage in restricting both the types and the frequencies of gene recombinations to a "recombination spindle" foster introgression of genes in groups rather than one at a time. Consequently, by careful study of a hybrid population and one of its parent populations it should be possible to detect a group of characteristics which are introgressing from the other unknown parent population. Once this group of characteristics becomes specified, it constitutes a critical taxonomic description, even though the unknown parent population has never been seen. Introgression takes place in direct relation to the degree of survival of hybrid segregates. Thus, its most rapid pace occurs under human husbandry by a breeder. Cultivated plants and weeds are man's respectively conscious and unconscious products of introgression. In nature, its rate is greatest where the habitat has been disturbed. It is here that new ecological niches are available to the new gene recombinations constituted in the hybrid segregates. As the previous ecological balance becomes restored, those recombinations most like the original parents will be the ones most likely to survive. Thus only a few genes will introgress at a time even under the most favorable natural conditions. Introgression is considered to be of greater fundamental biological significance the more gradual and imperceptible it is.

These concepts began developing in Dr. Anderson's mind some 15 years ago. Studies of natural populations in the field since then have verified all the gross aspects of his ideas. Refinements in technique are still desired.—*Elton F. Paddock.*

Introgressive Hybridization, by Edgar Anderson. 109 pages. New York, John Wiley & Sons, Inc. 1949. $3.00.

A CHAPTER OF EARLY OHIO NATURAL HISTORY[1]

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INTRODUCTION

In his *History of the Northern American Indians*, a manuscript probably written expressly for the use of Bishop George Henry Loskiel "to aid him in the preparation of his valuable *History of the Mission of the United Brethren among the Indians of North America*" (1), David Zeisberger left to posterity a treasure trove of observation not only on the contemporary Indians, on their life habits inside and outside of the Moravian mission communities, their political institutions, sociology, and religion, but also on the natural environment in which these living conditions had been formed and continued. He also showed the intelligent concern of the true historian about the interaction of Man and the forces of nature surrounding him, within a given region. The editors of Zeisberger's work correctly remarked (2) that the title, *History of the Northern American Indians*, was not given to the manuscript by its author, but by Bishop Edmund de Schweinitz, Zeisberger's biographer. Zeisberger, "had he named it, would probably have called it, Notes on the History, Life, Manners, and Customs of the Indians."

It is to be regretted that Zeisberger did not himself cast these raw materials into a mould of true history writing, shaped by the same sound judgment as had guided him in the assembling of his notes for the use of a man who, as far as historic vision is concerned, was by far his inferior. Evidently Loskiel did not perceive, in Zeisberger's work, the spark of genius that makes it so different from the general run of historiography of the period.

There is, in Zeisberger's entire era, only one contemporary writer who, like him, conceived of history as the product of ethnologic inheritance and geographic environment: Justus Möser (1720–1794), a Westphalian author, by profession a jurist; in his *Osnabrückische Geschichte* (3), a history of the city of Osnabrück. The introduction to this book, in which he developed his ideas of historiography, was separately published in 1773, by Herder and Goethe in their collection of essays, entitled *Fliegende Blätter von deutscher Art und Kunst*, as one of the clarion calls of the *Sturm und Drang* movement which heralded in both German Classicism and Romanticism. It is to be doubted whether Zeisberger ever heard of Möser; yet there is an undeniable similarity in the two men's basic notion of history and, hence, in their approach to their subject.

As far as I know, Möser's *History of Osnabrück* is the first attempt ever made at the writing of history on the basis of regional geography. Zeisberger intended the very same thing. That is clearly evident from the materials which he collected as essential for the use of the historiographer, as well as from frequent inner connections which he points out, in these notes, between the natural scene and the behavior of the people that inhabit it. Due to its very nature and purpose, there is absent, in Zeisberger's work, the well planned outer form which characterizes Möser's book; yet, by virtue of his clearly realized ideas on worthwhile historiography and its methods, Zeisberger is fully the equal of Möser.

Like Möser, who had chosen his native city of Osnabrück as a typical region for his study of the specific physiognomy of Westphalia and its history, Zeisberger focused his observations on a locality which not only did he intimately know, but

[1]This article forms part of the research done by Dr. Mahr for The Ohio State Archaeological and Historical Society in connection with the restoration of the Moravian Mission town of Schönbrunn. The Society contemplates a detailed publication of these studies when completed.

which also he considered singularly representative as an area of contact between the aboriginal American scene and the superimposed foreign culture of the Moravian mission system. It was the Tuscarawas valley and, in particular, the mission community of Schönbrunn, which he had founded and where he worked from 1772 to 1777.

In the following pages the attempt has been made to present Zeisberger's regional materials of the Schönbrunn area in such a way as to do justice to his basic idea.

(I) The Forests

Zeisberger (4) gives the following general description of the forests of the Tuscarawas region:

> "The forests contain mainly oak trees; other kinds of trees are, however, also found. They are not dense, but generally sufficiently open to allow comfortable passage on foot or horseback. There are five varieties of oak, white-oak, black-oak, red-oak, Spanish-oak, and swamp-oak. The red-oak has very narrow, small leaves and bears little colored acorns, such I have seen nowhere else. Besides these, hickory trees of three sorts, ash, white and red beech, sassafras, in some places very thick, poplar and chestnut are the kinds generally found on high lying land. In the bottoms there are walnut, linden, maple, water-beech, that grow near to the water and often attain great height and girth, hawthorne and crabapple."

This description clearly distinguishes between associations of the higher lying lands and those of "the bottoms;" that is, the upland forest and the swamp forest.

In the passages following this description, either immediately or in later pages of his book, Zeisberger supplements his catalogue of the primary species of both forest types by a list of secondary species. The overall result is a rather complete picture of the region's plant ecology. That is all the more significant since the region's deforestation, within the last one hundred years, has made it impossible to include Tuscarawas County in the ecological survey currently carried on in the counties farther down the Tuscarawas where the original forest had been less interfered with. Zeisberger's species, as well as the notes written by the editors of *ZH* (5), have been carefully checked in the light of present-day ecology and taxonomy; necessary corrections were made, and the facts restated in the appropriate terminology of the respective fields (6).

(a) The upland forest

(1) *The Flora of the Upland Forest Area*

The upland forest such as described by Zeisberger was clearly dominated by an oak-chestnut-tulip association, with occasional stands of beech-maple, and oak-chestnut, in between; along the rivers and creeks, hemlock seems to have been frequent, though probably not forming forest areas. This entire forest picture is not different from that of the lower Tuscarawas region, with its well established plant ecology.

Partly from field experience, and partly from plant-ecological surveys, the following species may be safely claimed for the Tuscarawas valley, in the 1770's, and for the Schönbrunn area, in particular:

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature* (acc. to *DFI*)
White-oak	*Quercus alba* L.	
Black-oak	*Quercus velutina* Lam.	
Red-oak	*Quercus rubra* L.	*Qu. coccinea* Muench, Scarlet Oak
Chestnut	*Castanea dentata* Marsh.	

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature* (acc. to *DFI*)
Poplar	*Liriodendron tulipifera* L.	
Sugar Tree (Lenape: *Achsünnamünschi*, "Stone Tree")	*Acer Saccharum* Marsh, Sugar Maple	
Hickory (3 sorts)	Carya species	*Carya cordiformis* (Wang.) Koch, *C. ovata* (Mill.) Koch, *C. tomentosa* (Lam.) Nutt.
Ash	**Fraxinus americana* L.	
White and Red Beech	Only one species: **Fagus grandifolia* Ehrh	*Rapid growth results in much sap wood which is white; slow growth results in much heartwood which is reddish; ACM.*
Sassafras	*Sassafras variifolium* (Salisb.).	*Sassafras albidium* (Nutt.) Nees
Walnut	*Juglans cinerea* L. **Juglans nigra* L.	
Poison Vine	**Rhus toxicodendron* L. Poison Ivy	*Rhus radicans* L.
Hazel Nut	*Corylus americana* Walt.	
Wild Cherry	*Prunus serotina* Ehrh. (the common wild cherry)	The Wild Black Cherry
	Prunus pennsylvanica L. (and probably *Prunus cuneata* Raf.)	The Wild Red Cherry (*Prunus virginiana* L.) *probably not in this region.—ACM.*
Plums	*Prunus americana* Marsh.	
Wild Grapes	*Vitis aestivalis* Michx. *Vitis vulpina* L.	
Mulberry	*Morus rubra* L.	
Wild Gooseberry	*Ribes cynosbati* L.	*Grossularia cynosbati* (L.) Mill.
Wild Current (black)	*Ribes floridum* L'Her.	*Ribes americanum* Mill.
Cranberry (Lenape: *Pakilun* [*ZH: Rakilun, ACM*])	*Viburnum opulus* L. (the tree cranberry)	*Viburnum tribolium* Marsh; not really a cranberry
Wild Strawberry	*Fragaria virginiana* Duch.	
Elm	**Ulmus americana* L.	
Spruce (*error*)	(*Picea mariana* Mill., Black or bog spruce)	(?) *Tsuga canadensis* (L.) Carr., Hemlock
Pitch Pine	*Pinus rigida* Mill.	
(Len.) *Wiseweminschi*, "the yellow tree"	*Cladrastis lutea* Michx.	
Red Cedar	**Juniperus virginiana* L.	
Wild Citrons or May Apples	**Podophyllum peltatum* L.	
"Wild potatoes and wild parsnips" (?)	**Ipomaea pandurata* L.	Questionable; more likely **Apios americana* Medic.; or **Helianthus tuberosus* L., the Jerusalem Artichoke

*Also found in the swamp forest community.

Zeisberger never loses sight of Man as an essential member of the biotic association of the area; nor does he omit a pertinent remark about certain animals in relation to certain plants, or about either of the two in relation to Man.

Nothing could have better demonstrated the nature of the Tuscarawas forests than his simple statement: "They are not dense, but generally sufficiently open to allow comfortable passage on foot or horseback." In his introductory characterization of the forests (7), he takes care to keep separate the tree community of the forest "on high lying lands"; and that of the swamp forest, "in the bottoms." His remark, that "the forest is mainly oak forest," (8) expressly points

to the oaks as the dominant genus of the former community which alone he defines as "forest" (*der Busch*) (9). The tree community "in the bottoms" clearly did not measure up to his Central European notions of *Busch* (*Wald*), although he is careful throughout to assign to it the appropriate species of trees, as well as of the accessory vegetation. His occasional descriptions of species are concise and competent, and it is rare that he confuses them. His description of what he calls the red-oak ("very narrow, small leaves and bear little colored acorns,") (10) really applies to the scarlet-oak, *Quercus coccinea* Muench; nor is his "spruce tree" (11) really a spruce but a hemlock, *Tsuga canadensis* (L.) Carr.; the error also appears in the notes (12). Both the primary and secondary vegetation of the forest communities is significant to Zeisberger mainly as a means of support for the human species inhabiting the region. No fruit-bearing tree or plant is mentioned without also mentioning the use made of such wild fruit, frequently with some comment on its taste or even on the process of utilizing it to the consumers' best advantage. Evidently describing *Carya tomentosa* (Lam.) Nutt., he writes about "the hickory nut," as follows (13):

> " . . . the hickory nut, found in great plenty in some years and which the Indians gather in large quantities and use not only as they find them—they have a very sweet taste—but also extract from them a milky juice used in different foods and very nourishing. Sometimes they extract an oil by first roasting the nut in the shell under hot ashes and pounding them to a fine mash, which they boil in water. The oil swimming on the surface is skimmed off and preserved for cooking and other purposes."

He discriminates between the white and black walnut, according to the color of their wood, adding that "the latter is very much used by cabinet makers for tables, chests and other things. The nuts, the one variety having a very hard shell, are eaten, but are very oily." He mentions that "the one sort" of wild cherries "grows on high thick trees, which are found in large numbers" (*Prunus serotina* Ehrh., the Wild Black Cherry), and that these trees "yield a very fine red wood that is well suited for cabinet work." He also remarks that the wild grapes "growing on high ground or hills" (*Vitis aestivalis* Michx., and *Vitis vulpina* L.) are "the best," while "those found in the bottoms are very sour" [*Vitis riparia* Michx.]. He states (14) that

> "with the white walnut bark, used externally and internally, they [the Indians] effect many cures. Laid upon flesh wounds this relieves pain at once, prevents swelling and accelerates healing. Applied externally in case of toothache, headache, or pain in the limbs, this brings speedy relief."

The most detailed of Zeisberger's comments on trees in relation to human existence is that on the sugar maple (*Acer saccharum* Marsh) and the boiling of its sap into sugar. He writes about it, as follows (15):

> "Sugar trees are usually found in low, rich soil, sometimes, also, on higher land and in more northerly regions [than the Tuscarawas valley, ACM] even on hills, where, however, the soil is very moist. The Delawares call this tree the *Achsunnamunschi*, that is, the stone tree, on account of the hardness of the wood. The Mingoes give it a name signifying the sugar tree, as do the Europeans. From the sap of the tree sugar is boiled. This is done by the Indians in the early part of the year, beginning in February and continuing to the end of March or beginning of April, according as spring is early or late. In this region [the Tuscarawas valley, *ACM*] it is possible to boil sugar even in fall after there has been frost and in winter, if the season is mild. For as soon as the trees thaw a little the sap begins to run and then the trees are tapped. As, however, at that time of the year the weather is very uncertain and it is possible that there should be a cold wave at any time, it is hardly worth the effort to make the necessary arrangements and is hardly ever done, unless some one be driven of necessity to provide sugar for the household. This,

we ourselves [the mission community, *ACM*] have been obliged to do and the sisters of our congregation have already boiled a quantity of sugar for congregational love-feasts, shortly before Christmas."

(2) *The Fauna of the Upland Forest Area*

Zeisberger's discussion of the animals, in the Tuscarawas region, with Schönbrunn as its center, presents a rather clear survey of both the dominant and accessory species such as typical of the upland forest. Even as in his presentation of the area's forest flora, so he was guided, in the order in which he presents the fauna, by considerations of their usefulness rather than of systematic taxonomy.

From Zeisberger's notes (16), we can put down the following species of mammals, birds, reptiles, and insects as zoologically complementing the plant community of the forest areas in "the high-lying places" at and about Schönbrunn:

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature*
Mammals:		
Deer	*Odocoileus virginianus* Boddaert	.....
Bear	**Ursus americanus* Pallas	.....
Elk	*Cervus canadensis* Erxleben	.....
Panther	*Felis couguar* Kerr, Puma	.....
Wild Cat	*Lynx rufus* (Fuldenstaedt)	*Lynx rufus* Schreber
Red Fox	*Vulpes fulva* Desmorest	.....
Black Fox	Variety of *Vulpes fulva*	.....
Gray Fox	*Urocyon cinereoargenteus* Schreber	.....
Raccoon	*Procyon lotor* L.	.....
Opossum	*Didelphis virginiana* Kerr	.....
Pole-Cat	*Mephitis mephitis* Schreber	.....
Grey Squirrel	*Sciurus Carolinensis* Gmelin	.....
Black Squirrel	Black variety of the former	.....
Red Squirrel	*Sciurus hudsonicus loquax* Bangs	.....
Ground Squirrel	*Tamias striatus* Rich	This is the Chipmunk
Flying Squirrel	*Sciuropterus volans* (L.)	*Glaucomys volans* (L.)
Ground Hog	*Marmota monax* L.	.....
"Very large variety of wild cat, other than the kind already mentioned" (17)	*Lynx canadensis* Kerr	.....
Hare	*Lepus floridanus mearnsi* Allen	.....
Wolf	.....	*Canis lupus* L.
Mice very common	*Peromyscus leucopus* Raf	.....
Birds:		*(The Bird nomenclature in this column is according to The A.O.U. Check List of North American Birds, 4th edition.—ACM.)*
Wild Turkey	*Meleagris gallopavo silvestris* Vieill.	
Pheasant (*error*)	*Bonasa umbellus* L. the Ruffed Grouse (or pheasant).	
Heath Grouse	*Tympanuchus americanus* Reich., the prairie hen	*Tympanuchus cupido americanus* Reich., the Prairie Chicken
The Wild Pigeon	*Ectopistes migratorius* L.	Passenger Pigeon
Turtle-Dove	*Zenaidura macroura carolinensis* L.	Mourning Dove
Partridge or Quail (*in Engl.*)	*Colinus virginianus* L.	Quail (Bob-White)
Eagle	**Haliaetus leucocephalus* L., The Bald Eagle	Never nested in the region.—*ACM.*
Forked Eagle (Lenape: *Chauwalanne*)	**Elanoides forficatus* L., The Swallow-tailed Kite	Not known to have nested in the region.—*ACM.*
The Hawk	*Buteo borealis* Gmelin, The Red-tailed Hawk	.....

*Also found in swamp forest area.

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature*
The Stone-Falcon	*Falco peregrinus anatum* Bonaparte, the Peregrine Falcon, or Duck Hawk	"
The Pigeon-Hawk	**Falco columbarius* L.	"
Description of Woodpecker	*Melanerpes erythrocephalus* L.	"
Redheaded Woodpecker	**Dryobates pubescens medianus* Swains., the Downy Woodpecker	"
	**Dryobates villosus* L., the Hairy Woodpecker. "The former is smaller and much more abundant."	
Yellow Woodpecker	*Colaptes auratus luteus* Bangs, the Flicker (or Yellow Hammer [?])	"
Green Parrots	*Conurus carolinensis* L., the Carolina Paroquet	*Conuropsis carolinensis ludovicianus*, Gmelin., the Louisiana Paroquet
Owls	*Bufo virginianus* Gmelin, the Great Horned Owl	"
"A small owl"	**Otus asio* L. ("doubtless the ubiquitous Screech Owl")	"
Crows	**Corvus brachyrhynchus* Brehm.	"
The Raven	*Corvus corax principalis* Ridgw.	"
The Whippoorwill	*Antrostomus vociferus* Wilson	"
The Mosquito-Hawk	*Chordeiles virginianus* Gmelin	*Chordeiles Minor* Forster
[*Die Amsel*] Blackbird (*European terminology, ACM.*)	*Planesticus migratorious* L., the Common American Robin	*Turdus migratorious* L.
The Blue-Bird	*Sialia sialis* L.	"
The Mocking-Bird	*Mimus polyglottus L.*, "Very rare in the locality now"	"
Descr.: "A certain yellow bird with black wings . . . "	*Astragulinus tristis* L.	*Spinus tristis* L.
Descr.: ". . . another kind, orange in color with black spots . . . hangs its nest . . . on branches of trees"	*Icterus galbula* L., the Baltimore Oriole	"
Descr.: "Another bird, light red"	*Piranga rubra* L., the Summer Tanager	"
Descr.: ". . . another red bird with black wings"	*Piranga erythromelas* Vieill., the Scarlet Tanager	"
The Cat-Bird	**Dumetella carolinensis* L.	"
The *Gut-Herr* [—*Häher*] (Blue Jay, *ACM.*)	Translation omitted in *ZH;* no note.—*ACM*	*Cyanocitta cristata* (L.) Strickland
"The Turkey Posser" (Buzzard)	**Cathartes aura septentrionalis* Wied.	"
Swallows	*Hirundinidae	"
Finches	"Several Fringillidae (sparrows), most of the thrushes (Turdidae), and probably some of the warblers (Mniotiltidae)"	"
"Tom-tits"	*Baeolophus bicolor* L., the Tufted Titmouse, and, probably, *Parus atricapillus* L., the Chickadee	"

*Also found in swamp forest area.

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature*
Wrens	*Thryothorus ludovicianus* Lath., the Carolina Wren, "is the most abundant and conspicuous species in this region"	.....
Honey-Bird	*Archilochus colubris* L., the Ruby-throated Humming-Bird	.....
Reptiles:		
Rattlesnakes ("not as numerous as in some regions that are stony and mountainous")	*Crotalus horridus* L.	.....
Copperheads ("their bite is as venomous as that of the rattlesnakes")	*Ancistrodon contortrix* L.	*Agkistrodon mokoson* Daudin
Vipers ("Their bite also is venomous")	*Heterodon platyrhinus* Latr., probably *var. nigra*. "The spreading viper or hissing adder, an entirely harmless snake generally thought to be poisonous"	*Heterodon contortrix* Latr.
Blacksnake	*Zamenis constrictor* L. Black Snake, or Blue Racer	*Coluber constrictor* L.
Descr.: ". . . green snakes, white-bellied and more than a foot in length and harmless"	*Liopeltis vernalis* Dekay, the Green or Grass Snake	*Opheodrys vernalis* Harlan
"Lizards . . . rarely found. One variety, not above 5 or 6 inches in length, is said to be poisonous"	.....	Either Pine-Tree Lizard, *Sceloporus undulatus* L., or the Blue-Tailed Skink, *Eumeces fasciatus* L.
"Other varieties, some very small, come into the huts that are reared in the forest and are harmless."	.....	The young of the preceding species. In this region, there is no species with "very small" adults.
". . . variety of land tortoise in these parts . . . hard shell, . . . small and very prettily marked"	*Cistudo carolina* L., the Box or Wood Turtle	*Terrapene carolina* L.
Molluscs:		
Snails	*"Helix and related forms"	.....
Arthropoda:		
Ticks	.....	*Family Ixodidae
Mosquitoes	.....	*Genera Culex, Aëdes, Anopheles, Psorophora, *et al.*
"great and small gad-flies"	*"Tabanus, Chrysops, etc."	.....
Bees	Apina	*Apis mellifera* L., the Honey-Bee; *not native American, but early escaped.—ACM.*
Wasps	Vespina	*Several families and genera of Hymenoptera
Bed-bugs	.....	*Cimex lectularius* L.
Fleas	.....	Genus Ctenocephalus: Cat Flea, Dog Flea; possibly also *Pulex irritans* L., the Human Flea

*Also found in swamp forest area.

Zeisberger not only records his animal species in the order of their dominance but he also does what he had done in discussing the trees and plants: he regards them in relation to Man. As the most important forest creature, he lists the Deer. His excellent description of the Virginia Red Deer (18) reads as follows:

> "In the first place, there are the deer, whose skins are much used in barter and trade by the Indians. Their horns are not straight, but bent toward each other and have prongs. From May until September they are red, after that they lose the red hair and their hide is covered with long, gray hair, which is their winter coat. At about the beginning of the year they shed their horns; new ones grow in spring. These are at first and until they attain their full size, covered with a thin skin, which peels off when the horns harden. The tail is about a foot long and stands up straight when they run. As the under side of the tail is white it is possible to see them running at a great distance. The young are born in June or about that time, are red, spotted with white, until the fall when they become gray. Deer have young each spring, sometimes two. As, however, they are hunted so persistently at the call of trade, their numbers diminish with each year, even though the forests are of vast extent, for the hunters are many. A large buckskin is valued at a Spanish dollar; two doeskins are regarded as equal in value to one buckskin."

In another place of his book, Zeisberger makes this remark (19):

> "As an Indian shoots from fifty to a hundred and fifty deer each fall, it can easily be appreciated that game must decrease."

In spite of the deer's satisfactory birth rate, Zeisberger is concerned about the survival of both the hunters and the hunted. His and the Moravian mission's economic policy was inspired by the realization that the game resources were being recklessly exploited, and that, for the future, there was only one road left open toward the Indians' racial survival: a determined change, away from the life of the roaming game-exterminator, to the sedentary existence of the farmer and cattle-raiser. What was practiced, in this respect, in the Tuscarawas missions, was a highly successful move in the right direction, as long as it lasted. It was not the Moravians' fault that all their honest efforts came to naught; their and their converts' neutrality, intended to be a blessing, was held against them by both contending parties of the Revolutionary War, with the result that the missions were destroyed and abandoned.

The Bear ranks next in Zeisberger's survey. His description reads, as follows (20):

> "The bear is quite black, has short ears, a thick head and quite a sharp snout. It has but a very short tail and great strong claws on his feet. It can easily climb the trees and bring down chestnuts and acorns. This is done, however, only when these are not ripe and do not, therefore, fall down. They generally break off the branches, throw them down and then climb down to consume the nuts. Where there is food and mast they are found. It is as if they knew that in this or that region it would be good for them to live. In the fall, when the Indians hunt deer, they take no notice of the bears; otherwise, they would spoil their fall hunting. They do, however, notice their tracks and whither they lead. At the end of December the bears, having fattened, seek their winter quarters, which they prepare in the trunks of hollow trees or in caves or the thickest part of the forest, where many old trees lie piled up. They leave their winter quarters in early spring; if they have young, of which there are generally two, not until May. During this period they are said to eat nothing, but to live on their own fat. . . . Their skins are no great object for trade, hence the Indians prefer to use them for their sleeping places, for which the long hair makes them peculiarly useful."

In describing the Elk, Zeisberger remarks correctly that "the English distinguish between the elk and the stag in Europe" (21): the European Elk is what in America is called a moose; while the European Stag (*Cervus elaphus* L.) is a close relative of the American Elk (*Cervus canadensis* Erxleben). Again he adds some economic comment: "As the skins are very thick and heavy and of no particular value, elk do not tempt the Indians to the chase."

He describes the Buffalo, but merely as a thing of the past. He writes:

> "At one time these animals appeared in great numbers along the Muskingum but as soon as the country begins to be inhabited by the Indians, they retire and are now only to be found near the mouth of the above named river. Along the banks of the Scioto and further south, both Indians and whites say that they may be seen in herds numbering hundreds. That is two or three hundred miles from here."

Of the Panther (Puma, Mountain Lion, *Felis couguar* Kerr) Zeisberger gives a particularly lively description, obviously inspired by admiration for this sturdy cat, as well as by the wholesome respect which the Indians had for it as a potential enemy. Follows Zeisberger's description (22):

> "The panther has a head and face like a cat, its legs are short and the paws are armed with sharp claws. It is a beast of prey of uncommon strength. Its tail is long, compared with that of the cat. Deer it is able to catch at will. If it spies one and is desirous of capturing it, the panther crawls along the ground behind fallen trees or through the thicket until it is sure of capturing the deer in one leap. Then it springs upon its prey, seizes it with its claws and does not release its hold until the victim is dead. If it misses its aim at the first spring, it never attempts a second. When the deer has been killed, the panther devours but a small part, leaving the rest. When again pressed by hunger it seeks a new game. At a distance of ten yards from a tree, the panther can leap ten yards up the tree and leap the same distance from the tree. It is not known that a panther has ever done the Indians injury without provocation. Should an Indian get near the place where the young are kept, then he is in great danger and if he does not know what to do under such circumstances, is almost sure to lose his life. He must never turn his back upon the panther, thinking that he can escape. He must not take his eyes off the animal, and if he has not the courage to shoot, gently walk backward, until he is a good distance away. If he shoots and misses, then he is in imminent danger and must keep his eyes fixed on the panther. It has happened that in this way Indians have saved their lives. It has occurred that a bear has fought so long with a panther, near to where the latter had its young, that both fell dead. The skin of the panther is gray in color, mixed with reddish hair."

In discussing the Raccoon, Zeisberger remarks (23): "The flesh is wholesome and tastes like bears' meat and its skin is useful to hatters."

He gives a clear account of the Opossum's marsupial nature, as well as of its habit of "playing possum," stating, in conclusion, that "the flesh of the creature tastes like pork and is eaten by the English, rarely by the Indians."

His excellent description, vivid and concise, of the Pole-Cat (under its Pennsylvania Dutch appellation, *Piss-Katze*), contains these passages (24):

> "If one's person or clothes have been infected by the moisture, it is necessary to bathe and change before returning into company. Even dogs, when they kill the animal, find the stench unbearable. Yet the flesh of the creature is eaten by the Indians. It is said to be very good and not to have offensive odor."

Evidently he successfully combatted the temptation to ever taste it himself.

About the Wolf, Zeisberger records the following pertinent observations (25):

> "Wolves are very numerous, most are gray, some are almost black. As

> their skins serve no useful purpose they are not much valued, the Indians do not pursue them, unless, they catch them tearing skins or devouring meat they have carefully laid away. Sometimes the wolves break into their hunting huts and do much damage. They rarely attack men, never when there are deer to pursue. The latter they attack in summer or winter, never stopping pursuit until a victim has been captured. Occasionally, the deer save themselves in creeks and rivers, swimming a great distance down stream, so that it is impossible for the wolves to trace them. When a wolf has caught a deer and killed it, it will not at once consume the flesh, but go to the highest hill nearby and call its comrades, by howling. When these have assembled they devour the deer together."

With the rodents Zeisberger deals briefly, not omitting, however, their significance for the human community. Thus, he remarks, about the squirrels, that "their flesh is tender, and eaten by the Indians in case of sickness or when they are very hungry for meat."

Of the "ground squirrel" (Chipmunk, *Tamias striatus lysteri*, Rich.) Zeisberger states that it does "great damage in the fields of the Indians, not only digging out the corn when it has been planted, but also pumpkin and melon seeds."

"The Groundhog," he writes, "lives on grass and is very fond of melons and pumpkins. . . . The flesh is toothsome and eaten by the Indians." (26).

Zeisberger devoted much attention to the bird population of the forests. The Wild Turkey is competently and concisely described, as follows (27):

> "Wild Turkeys may be seen in the fall in flocks numbering hundreds. In the summer they disperse in the woods, this being the time for hatching the young. In winter their plumage is of a shining black, with white spots on the wings; in summer it changes to light brown. When the time comes for laying the eggs, the Indians seek them, as they are very fond of them."

Repeatedly he uses the name of a European bird for an American one resembling closely or distantly the former. Thus, in speaking of pheasants, he really refers to the Ruffed Grouse (*Bonasa umbellus* L.) which, moreover, had long received, in this country, the popular name of "pheasant," when Zeisberger first met with the species. He states that

> "Pheasants are not valued by the Indians, though their flesh is palatable. They fall victims, however, to birds of prey. Were it not for the birds of prey the woods would swarm with them, for the hen lays above twenty eggs at one time."

What he calls the "Heath-Grouse" is really the Prairie Chicken (*Tympanuchus cupido americanus* Reich.), which, as he correctly states (28), is "larger than the pheasants" (Ruffed Grouse). He adds the information that "they are not valued by the Indians any more than the pheasants."

Zeisberger's "Turtle-Doves," which "are smaller than the [passenger] pigeons [previously described] and are always found in pairs," really are Mourning Doves (*Zenaidura macroura carolinensis* L.); and his *Patrisel* are "Partridges or Quail" (*Colinus virginianus* L. the Bob-White), as he adds in English. He describes them as follows (29):

> "Partridges . . . are small, neatly formed chicken fowl. In the fall and winter they fly in broods. In the settlements they like to remain near the plantations, as they find the food they like in the fields. The flesh is tender and of a fine flavor. They are favorites with all people, being innocent and harmless birds."

He correctly points out the significant ecological fact that "in the settlements they like to remain near the plantations, as they find the food they like in the fields." A note to Zeisberger's book (30) quotes J. M. Wheaton (31) as stating that

" . . . it [the Bob-White] was probably absent or at least confined to but a few localities in the State at the time of the first settlement and has steadily increased in numbers as the forest has been cleared away."

Similar observations have been made with regard to the spreading, in the Old Northwest, of the Cardinal (*Cardinalis cardinalis* L.) and the American Robin (*Turdus migratorius* L.) both of which were drawn, by the cultivation of fields, into formerly forested areas and, in particular, into the neighborhood of human habitations where they could find with ease the livelihood that best suited their needs; see also below, p. 57.

Zeisberger gives a good picture of the multitudinous appearance of the Passenger Pigeon (*Ectopistes migratorius* L.), once an essential member of the forest community, but now extinct. His description reads, as follows (32):

"The wild pigeon is of an ash-gray color, the male being distinguished by a red breast. In some years in fall, or even in spring, they flock together in such numbers that the air is darkened by their flight. Three years ago they appeared in such great numbers that the ground under their roosting-place was covered with their dung above a foot high, during one night. The Indians went out, killed them with sticks and came home loaded. At such a time the noise the pigeons make is such that it is difficult for people near them to hear or understand each other. They do not always gather in such numbers in one place, often scattering over the great forests."

Zeisberger then proceeds to list the birds of prey, starting with two species, the Bald Eagle and the Swallow-tailed Kite, that probably never nested in the Tuscarawas forest area. The other species mentioned are resident members of the upland forest community.

The minor species that complete the picture of the bird population of that forest have, in part, been described, rather than named, by Zeisberger. From these descriptions it has been easy to identify the species Zeisberger had before his eyes. In only one case, it is doubtful what bird he had in mind; he writes: "Another kind of birds, light-red in color, is particularly beautiful. . . ." This may be the Summer Tanager (*Piranga rubra* L.), but it is also possible that Zeisberger was describing the Cardinal (Redbird, *Cardinalis cardinalis* L.), although some ornithologists doubt whether this bird, today inseparable from the Ohio scene, had, in the 1770's, started on his invasion of the land west of the Ohio River.

It is of interest to the linguist, rather than the ornithologist, that Zeisberger, in clearly describing the American Robin (*Turdus migratorius* L.), calls it "The Black-Bird" (33). A note in Zeisberger's book (34), pertaining to this seeming incongruity, reads as follows:

"A European bird, *Merula merula*, a near relative of our robin, is black, has habits like our robin, and is commonly known as the blackbird. Before the white settlers came, the robin doubtless lived in open places in the forest, so that in the author's experience it was met with only in breaks in the forest, usually remote from the Indian villages. With the opening up of clearings the robin made acquaintances with the white man and came to live in open groves and orchards. This the robin did in common with many of our other native birds which formerly lived only in the open places in the forest. With the coming of the white settlers these birds found congenial homes in the clearings and orchards where they were also less subject to the attacks of predaceous birds and mammals."

It is hardly doubtful that the European Blackbird, centuries ago, had undergone an analogous ecological transition from the forest clearings to the gardens and orchards of the human settlements. This is all the more plausible since the European Blackbird and the American Robin, in their appearance (apart from the

coloration), habits, and habitats, are so much alike that they are probably to be regarded as local varieties of each other.

Next, Zeisberger gives much attention to the snakes of the area. "Here along the Muskingum," he writes (35), "rattlesnakes are not as numerous as in some regions that are stony or mountainous." Nevertheless, they seem to have been frequent enough to be assigned first place among the reptiles of the Tuscarawas forest area. His description is nothing short of classical (as are so many of his descriptions), in that it combines excellent observation with a marvellous conciseness in the presenting of facts. It merits quotation in full:

> "The most dangerous snakes are the rattlesnakes. They are yellow in color, marked with black spots. The largest are about four feet long, sometimes more, and about as thick as an arm. The rattles are at the end of their tails, and often betray the snakes when they are not seen. These rattles appear to be a thin, transparent horny substance, arranged in links. From the number of links it is possible to tell the age of the serpent, one being added every year. It is a rare thing to find one with twenty rattles. When the rattling sound is heard, it is a sign that the serpent is angry, the trembling of the tail causing the rattling. Even when they glide along the rattles make a slight sound which can, however, be detected only by those well acquainted with the ways of the snake. They do not rattle unless something approaches them. Head and mouth are rather broad in proportion to the size. On either side of the mouth they have two very sharp teeth, which lie concealed in a skin sack until they want to bite, when they are able to move these forward with great swiftness. Hence, it is that when anyone has been bitten four little openings close together may be seen in the skin. If a rattlesnake has been killed, which often happens, as they do not seek to escape nor go out of the way for any one, and one draws forward the teeth with a little stick, a clear liquid spurts out of the bag lying at the root of the teeth. This is the poisonous juice. Undoubtedly, the teeth in themselves are also poisonous. Indians who have been bitten, even if they happen to be quite alone in the forest, know what to do. They seek certain herbs and roots that may be found anywhere and cure themselves of the bite, so that one rarely hears of death occasioned by the bite of this serpent. Horses or cattle bitten in the woods, where it is not possible to render immediate assistance, die in a short time. With proper management these animals may recover in twenty-four hours. With human beings a cure is not effected so quickly, and a curious thing is that the part where a human being has been bitten, becomes spotted like a rattlesnake. The fat of the rattlesnake is used by apothecaries."

Zeisberger is not correct in stating that "the teeth in themselves are also poisonous;" or that "the part where a human being has been bitten, becomes spotted like a rattlesnake." His statement about the other snakes of the forest region are, on the whole, authentic, although they contain a few minor errors; for instance, when he writes that the Viper's "bite is venomous." The snake which he describes (36) is obviously *Heterodon contortrix* Latr., "the spreading viper or hissing adder, an entirely harmless snake generally thought to be poisonous" (37). In describing the "Hornsnakes" (38) as separate in kind from the Copperheads which they are, he does no worse than does the professional herpetologist when, on the grounds of a minor peculiarity, he establishes a new species, or a variety of one recognized.

Zeisberger concludes his description of nine different snakes with a few miscellaneous remarks about the life and feeding habits of some of them. Again he emphasizes the fact that "none are so numerously represented as the rattlesnakes," and then he states (39) that

> "all of them, be they venomous or non-venomous, swallow whole whatever

they eat. Frogs, toads, birds, *Ground Squirrel* [English term used in German ms; Z. refers to the Chipmunk (*cf.* above, p. 55); *ACM*], squirrels, hares [rabbits ?], they devour; not in one gulp, however, but gradually. They start by the hindlegs and gradually draw [the creature] in; often this takes a long time. All snakes, in spring when they leave their holes in the ground, shed their old skin. Hence, one often finds an entire skin, in the exact shape of the snake, with the head and everything, only very thin. Black-Snakes, after having shed their old skin, look a very glossy black. When a rattlesnake bites itself—it does not happen except when it is incited to doing so out of anger and fury, incapable of avenging itself on anyone else—it speedily swells up, almost to the bursting point, so that it can no longer move away, and dies within a few hours."

So far, I have been unable to ascertain whether this latter statement is, or is not, correct; there is no reason why the venom should not effect its own carrier once that it has entered the blood stream with which, under normal condition, it is in no contact whatsoever. Nor have I been able to find out how much truth there is to the well-known story of the paralyzing fascination (also attributed to other, oldworld, snakes, I think, as early as Herodotus) of the rattler's eye; Zeisberger makes the following statement about it (40):

"This snake is said to possess another peculiar property, as witnessed both by Indians and whites, *viz.*, that of gazing with fixed eyes upon bird or squirrel and by a kind of fascination, stupefying them, so that they not only cannot escape, hard as they may try, but also that such a creature is forced to descend from its tree and come to the snake which then seizes it and gradually swallows it up."

This "descending from the tree and coming to the snake" is sure to be an overstatement, while there may quite well be something to the hynpotizing quality in the gaze of a snake approaching its prey on level ground.

In conclusion of his description of a "land tortoise" with "a hard shell . . . small and very prettily marked," he writes: "Flesh is also eaten" (41). The species is *Terrapene carolina* L., the Box or Wood Turtle. Excavations back of Zeisberger's log house, at Schönbrunn, are supposed to have yielded a great number of shells of this turtle although I am unable to substantiate this rumor; if it is true, there can be little doubt that Zeisberger himself had not been averse to cracking a turtle, once in a while, for his dinner.

"Lizzards are but rarely found here," writes Zeisberger (42). The scarcity, in the North American forest, of lizzards strikes the observer from Central Europe no less than the abundance, in both species and specimens, of turtles, in the freshwater bodies of America. Zeisberger's "one variety, not above five or six inches in length," which "is said to be poisonous," is either the non-poisonous Pine Tree Lizard (*Sceloporus undulatus* L.), or, less probably, the Blue-Tailed Skink (*Eumeces fasciatus* L.); less probably, because Zeisberger, careful observer that he was, would hardly have failed to notice, and to mention in a descriptive passage ,the beautiful blue of that lizard's tail. Here is what he tells about his lizard (43):

"Indians make much ado when they see them and try to frighten them away. They dwell in hollow trees, where they also keep their young."

Then he tells about "other varieties, some very small," which "come into the huts that are reared in the forests and are very harmless" (44). Since there is no species known in the region, with adults "very small," these "other varieties" must have been young specimens of the species listed above.

He mentions snails (evidently some species of genus Helix), adding that "from one variety spring, it is believed, the many large gad-flies which in the summer, in the months of July and August, worry the cattle to such an extent that during the day they cannot graze in the forest." Then he speaks of the saliva-like fluid

these snails deposit, "presumably containing the eggs of the animal, which are hatched out by the sun," and concludes: "from this [fluid], it is supposed that the pestiferous gad-flies are hatched out." This is one of the very few erroneous beliefs concerning natural phenomena, found in Zeisberger's book, which, however, he shared even with the professional scientists of his age (45).

"Wasps are found in large numbers," Zeisberger writes (46), without going into further detail or description; and "of bees," he states, "nothing was known when we came here in '72, now they are to be found in large numbers in hollow trees in the woods" (49). These bees, I have been assured by an entomologist, were not of the genus, Apina (48), but were European honey-bees (*Apis mellifera* L.) early introduced into the American colonies, from whence escaped swarms steadily spread the species westward. Zeisberger's remark about the absence of bees in the Schönbrunn region, prior to the coming of the Moravians, in 1772, is ecologically significant in that it indicates a lacking of the bees' principal food: pollen and nectar, which had been practically absent in the densely forested location, but later became abundant in the same area, after it had been cleared and, in a large measure, turned into orchards, whose bloom would naturally attract bees even from distant places and cause them to settle in hollow trees of the neighboring forest. The Indians, in turn, had long learned to use the honey in their diet, its possession being only disputed by the numerous bears which, besides, were also attracted by the fruit of the orchards, as is evident from Major McMahon's report, to Heckewaelder (49), about a visit, in 1792, to the site of the abandoned mission of Gnadenhütten.

(b) THE SWAMP FOREST

(1) *The Flora of the Swamp Forest Area*

In his general description of the Tuscarawas forest, such as quoted above (p. 46), Zeisberger characterizes the swamp forest, as follows:

> "In the bottoms there are walnut, linden, maple, water-beech, that grow near to the water and often attain great height and girth, hawthorne and crabapple" (50).

It has been previously mentioned (above, p. 46) that Zeisberger, when speaking of forests, did not include the tree growth "in the bottoms," which evidently did not correspond with his Central European concept of "forest" ("*Busch*"); yet he is careful to point out the dominant species of the swamp habitat; as well as to pay attention to the accessory members of the river bottom community.

The same method as applied above (p. 46) to the establishment of the upland community of plant species has been followed in regard to the swamp-land community; hence, the following species may be claimed for the Tuscarawas bottoms, and for those near Schönbrunn, in particular:

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature* (acc. to *DFI*)
Black Walnut	**Juglans nigra* L.	
Linden	*Tilia americana* L.	
Maple	"*Acer saccharinum* L., the silver maple is most abundant near the water, though **Acer saccharum* Marsh, the sugar maple, and *var. Nigrum* (Mx.) also occur in the bottom lands." (?)	
Water-Beech	"Most probably *Platanus occidentalis* L., the sycamore." (See *ZH*, note 119.)	
Hawthorne	Crataegus species	

*Also found in the upland forest community.

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature* (acc. to *DFI*)
Crabapple	*Pyrus coronaria* L. (and *Pyrus angustifolia* Ait.)	*Malus coronaria* (L.) Mill.
Hoop-Ash	*Fraxinus nigra* Marsh., the black ash	Hoop-Ash is correct.—*ACM.*
Honey-Locust	**Gleditsia triancanthos* L.	
Dogwood	*Cornus florida* L.	Flowering Dogwood.
Red Cedars	**Juniperus virginiana* L.	
Spruce Tree (*error*)	(*Picea mariana* (Mill.), Black or log spruce)	**Tsuga canadensis* (L.) Carr., the Hemlock
Elm Tree	**Ulmus americana* L.	
Stone Birch	*Betula nigra* L., the river birch	
Aspen	*Populus tremuloides* Michx., the American aspen	
Vines	**Vitis vulpina* L.	
Oak trees (*not expressly mentioned by Zeisberger as occurring in the bottoms*)	*Here is some confusion of species in the notes; (see ZH, notes 110a–110e)*	*The swamp forest species found in the area are:*
Swamp-Oak		*Quercus bicolor*, the Swamp White Oak
Spanish Oak (?)	*Quercus palustris* Muench	*Quercus palustris* Muench., the Pin Oak
Beech	**Fagus grandifolia* L.; (see above, p. 47)	
Hickory (*not expressly mentioned by Zeisberger as occurring in the bottoms*)		*Carya laciniosa* (Michx. f.) Loud. **Carya cordiformis* (Wang.) Koch
(*Descr.*): "a larger variety of chestnuts not fit to eat"	*Aesculus glabra* Willd., the Ohio Buckeye	
Wild Laurel "Laurel, also called the wild box"	"*Benzoin aestivale* L., the common spice-bush apparently"	
Poison Vine	**Rhus toxicodendron* L., "Poison Ivy"	*Rhus radicans* L.
". . . some poisonous trees".	"*Rhus vernix* L., the poison sumac, our most poisonous plant"	
Cranberries (Lenape: *Pakilun* [*ZH: Rakilun—ACM*])	*Vaccinium macrocarpon* Ait., the Common Cranberry	
Wild Citrons or May Apples	**Podophyllum peltatum* L.	
"Wild potatoes and wild parsnips" (?)	**Ipomaea pandurata* L.	More probably: **Apios americana* Medic., or **Helianthus tuberosa* L.—*ACM.*

*Also found in the upland forest community.

The trees and plants of the swamp forest, such as listed above on the basis of Zeisberger's pages, clearly hold a place of inferior economic importance for the natives of the area, as compared with the plant community of the forest on the "high-lying land." It seems, however, that, as a source of medicinal substances, they rated above the economically dominant forest area of the region.

Although Zeisberger expressly disclaims to be an authority on medicinal herbs and roots (51), he occasionally drops valuable hints at the pharmaceutical use of

some plants. Thus he states, with regard to Flowering Dogwood (*Cornus florida* L.), that "the rind of the root is used in the apothecary shops in place of Jesuit-Bark," that is, Cinchona bark, from which quinine is extracted. "The bark of stone birch trees" (*Betula nigra* L., the River Birch), "as of many others," writes Zeisberger (52), "the Indians pound fine, mix with water and use as a medicine." About the Spicebush, *Benzoin aestivale* (L.) Nees, which he calls Wild Laurel ["*wilder Lorbeer*"], (and, later, "Laurel, also called the wild box"), Zeisberger remarks that "its wood is used by the Indians for medicine and called by the English, spicewood;" "it has a strong odor and taste" (53). Later in the book (54), he informs the reader that "the wood is fine and hard," and that "the Indians make spoons of it. The main stem does not become thicker than a leg. The leaves are green summer and winter."

About the very plentiful crabapples of the region, he remarks that "the Indians, being very fond of sharp and sour fruit, eat them in abundance." This same bend of taste explains the Indians' liking for "Wild Citrons or May Apples." "The Indians enjoy eating the fruit," remarks Zeisberger (55), "which has a sour but pleasant taste." He adds the interesting information that "the roots are a powerful poison which, who eats, dies in a few hours' time unless promptly given an emetic."

(2) *The Fauna of the Swamp Forest Area (including the Lagoon and its Littoral Fringes)*

Here following, Zeisberger's notes on the animal life of the swamp forest in the Tuscarawas bottoms are presented in conformity with the list containing the animal species of the upland forest (see above, pp. 49). Included are amphibious species, that is, such as need a body of water for either their subsistence or the completion of their life cycle, or both. "The Lagoon" is a swampy meander loop of the Tuscarawas, at the foot of the Schönbrunn plateau.

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature*
Mammals:		
Bear	**Ursus americanus* Pallas	
Otter	*Lutra canadensis* Schreber	
Beaver	*Castor canadensis* Kuhl	
Muskrat	*Fiber zibethicus* L.	*Ondatra zibethica* L.
Birds:		
Wild Geese	*Branta canadensis* L., the Common Wild Goose	(*The bird nomenclature in this column is according to the A.O.U. Check List of North American Birds, 4th edition.—ACM*)
Wild Ducks	Several species; esp. the Wood Duck, *Aix sponsa* L.	
Sheldrakes	*Mergus americanus* Cassin, the Common Merganser; and *Lophodytes cucullatus* L., the Hooded Merganser	
Crane	". . . evidently *Grus mexicana* (Müll.), the sandbill crane, a bird now rare in Ohio." (*ZH*, p. 165, n. 182)	*Grus canadensis tabida* (Peters) acc. to Dr. Edward Thomas
Wild Swans	*Olor columbianus* Ord., the Whistling Swan, and *Olor buccinator* Rich., the Trumpeter Swan. . . . Both fit Zeisberger's description (*ZH*, p. 65). The former is now [1910] less rare	*Cygnus columbianus* Ord. *Cygnus buccinator* Rich.

*Also found in the upland forest area.

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature*
Eagle	**Haliaetus leucocephalus* L., the Bald Eagle	Acc. to Dr. Edward Thomas, it never nested in this region.
Loon	*Gavia immer* Brunn	
Descr.: ". . . a bird, fishing, that makes nest in the ground along steep banks of creeks or rivers, where it makes a hole just large enough to slip in"	*Ceryle alcyon* L., the Kingfisher	
Heron	*Ardea herodias* L., the Great Blue Heron	
Hoopoe (*"der Wiedehopf"*)	*Butorides virescens* L., the Green Heron	Identification uncertain; possibly the Green Heron, more probably *Ceryle alcyon* L., the Kingfisher.—*ACM.*
Starlings	Any one of the following Icteridae (Blackbirds): *Quiscalus quiscula aeneus* Ridgw., the Bronzed Grackle; *Molothrus ater* Bodd., the Cow-Bird; and *Agelaius phoeniceus* L., the Red-Winged Blackbird	
Snipe	*"Macrorhamphus griseus* (probably)"	Acc. to Dr. Edward Thomas, "probably Wilson's Snipe, *Capella delicata* (Ord.)"
"The gull is frequently seen near rivers and lakes"	Larus spec	
"two kinds of plover" (*follows description*)	*"Aegialitis vocifera,* larger variety"	*Oxyechus vociferus* (L.), Killdeer.

For other birds occasionally found in the Swamp Forest area, see above (p. 49), in list of birds of Upland Forest, species marked with (*).

Reptiles:		
Descr.: ". . . snake found here I have met with in no other region. The belly is quite red . . . found in the water and on land," etc.	Apparently *"Natrix fasciata* Shaw, the red-bellied water-snake . . . harmless though thought poisonous" (*Note 225*)	*Natrix erythrogaster* Shaw.; Dr. Edward Thomas thinks that the occurrence of this snake in the Tuscarawas valley is to be doubted.
Descr.: "Watersnakes spend much time in the water, live on fish and are not poisonous"	*Natrix fasciata sipedon* L.	*Natrix sipedon* L.
Descr.: "A kind of striped, brightly marked snakes, which are small and harmless"	*Eutaenia sirtalis* L., the Garter-Snake	*Thamnophis sirtalis* L.
"The River Tortoise . . . a species different from that found in Pennsylvania, which has a hard shell; . . . soft shell, . . . head small and pointed like that of a sea-tortoise, etc."	*Trionyx spinifer* LeSueur, the common Soft-Shell Turtle	*Amyda spinifera* LeSueur

*Also found in the upland forest area.

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature*
Amphibians:		
Descr.: ". . . another variety of fish, or whatever one may call it, resembling a small catfish, but having four short legs. It has a wide mouth and is about a foot and a half in length. The fins are short"	(*Note 242*): "This is a very peculiar reference to the water dogs, *Necturus maculatus* Rafinesque, the water dog with external gills, and *Cryptobranchus alleganiensis* (Daudin), the hell-bender or water dog without external gills."	*Necturus maculosus* Rafinesque Only *Cryptobranchus alleganiensis* leaves the water; *Nectaurus maculosus* belongs to the aquatic fauna.—*A CM.*
". . . frogs . . . of a brownish color, do not croak, but have a note like a short whistle"	"*Hyla pickeringii* Storer, a Tree Frog, living near the water in spring and early summer" (*note 249*)	*Hyla crucifera* Wied.
"Green Frogs are but rarely met with and only in rivers and brooks"	*Rana clamata* Daudin	*Rana clamitans* Latreille
"Bull Frogs . . . inhabit rivers and large brooks"	*Rana catesbiana* Shaw	
Molluscs:		
Snails	*"Helix and related forms"	
Arthropoda:		
Mosquitoes		*Genera Culex, Aëdes, Anopheles, Psorophora, *et al.*
Ticks		*Family Ixodidae
"great and small gadflies"	*"Tabanus, *Chrysops, etc."	
Wasps	Vespina	*Several families and genera of Hymenoptera.

*Also found in the upland forest area.

As in his treatment of previous associations, of both plants and animals, Zeisberger discusses the fauna of the swamp forest area in the light of its significance for the species *Homo sapiens*, the truly dominant one of all ecological provinces, because it dominates consciously and with a purpose. Although nowhere in his pages he says so in so many words, his anthropocentric brand of ecology was sustained by a strong awareness that nature existed solely for the benefit of man; an awareness supported not only by traditional theology but also by the secular rationalism of the era, commonly known as 'enlightenment'. Moreover, considerations of the greater or lesser usefulness of any given object of nature would all the more enter into the mind of a writer who was forced to subsist, remote from the cultural sources of his homeland, in the wilderness of a foreign continent, surrounded by, and to a high degree depending on, natives who themselves were at the mercy of their habitat's natural resources. Considering this, one cannot enough admire Zeisberger's objectivity as an observing and recording naturalist.

The Bear, as a member of the swamp forest community, is brought in only at the very end of Zeisberger's volume; in fact, in its concluding paragraph. Here, in describing a plant which he calls Laurel (currently named Spice-Wood, *Benzoin aestivale* (L.) Nees), he writes, as follows (56):

> "Laurel, also called the wild box, grows along river banks, or in the swamps in cool places or on the north side of mountains. It grows so thickly that it is impossible to get through. In swamps of laurel, bears like to make their winter quarters."

It should be noted that in his principal paragraphs on the bear and its life habits (57), the laurel swamps are not mentioned among the bear's preferences for winter quarters.

Of the Beaver and its amphibious life habits, he gives the following, excellent description (58):

> "The beaver was formerly found in great numbers in this region, but since the Indians have learned from the whites to catch them in stell-traps, they are more rarely found. A necessary thing in connection with the beaver-catch is a certain oil or spirit which the Indians prepare of various kinds of bark of trees and other aromatic things, which they place in the traps to decoy the beavers into them. The skins are always of considerable value. They are very industrious animals and, for their size, of uncommon strength. Beaver dams of such dimensions are found in creeks (59), that it might be imagined that they had been built by human hands. Such dams they build when there are many together, for they work harmoniously, at night, in order to dam up the water and often put a considerable piece of land under water in course of their operations. In the middle of the dam they build their dwelling places that are raised above the water, wood and earth being the materials used. As their dens are in the middle of the lakes they cannot be easily reached. In the front part of the mouth they have four quite broad and very sharp teeth, two above and two below. With these they are able to gnaw through trees that are nearly a foot in diameter. When the tree is down they divide it into pieces of such size that they are able to manage them. These pieces carried into the water, they join together in such a fashion that the water cannot tear them apart. I have myself seen in quite a large creek a beaver dam, in which the beavers were still undisturbed at home, so that I could observe their habits and work. The dam extending straight across the creek, reached three feet above the water, so that it was possible to cross the creek dry shod, and put several acres of land under water. In another place, where the water had threatened another course, they had been obliged to build another dam, made of earth and branches of trees. Had this dam not been so far from human habitation, one might have thought it had been constructed by men. The animals are of a dark brown color, have short legs and broad feet, adapted to swimming and armed with short claws. The tail is broad and flat. At the end it is broadest, smooth, without any hair, and looks as though covered with fish scales. The tail furnishes the best flesh and is much liked by the Indians. It has an appearance different from the rest of the animal's flesh, being more like fish meat. As the skins always bring a good price, the Indians hunt these animals constantly."

This description is accompanied by an editorial note (60) stating that

> "the steel trap was another white man's invention which, placed in the hands of the Indians, proved most destructive to some of the animals which formerly held their own against the less effective methods of the Indians. The price paid for the pelts by the whites, was of course an additional factor in the destruction of many of the native animals."

Here was another case of exstinctive hunting mainly due to "improved" equipment furnished by the white intruders who, moreover, put a premium on the reckless exploitations of the hunting grounds, hastening thereby the economic disruption of the natives, which eventually led to their doom.

About the Muskrat Zeisberger (61) makes the pertinent statement that, being "able to live in or out of the water," it

> "is in many respects most like the beaver. Its tail is not broad as that of the beaver, but oval-shaped. Their dwellings are in the water, but so arranged that they can, according to inclination, be in the water or in a dry place. A great quantity of odorous matter is found in the body of this animal. The odor is unpleasant when too strong, but a little of it is agreeable."

The greater or lesser food value, for the Indians, is stressed by Zeisberger in his description of quite a number of the birds found on or near the water. Thus he records (62) that the male of the "Tree-Duck" (*Aix sponsa* L., the Wood Duck) "is the most beautiful of the water-fowls and very good to eat," evidently not exclusively to the Indian taste. About the Sheldrake (*Mergus americanus* Cassin, and *Lophodytes cucullatus* L.) he states (63) that "they live on fish, their flesh having the taste of fish. Indians rarely use them for food, though the flesh of some is very palatable." According to a note (64), the latter remark seems to apply to *Lophodytes cucullatus* L., "the Hooded Merganser, which is said to be quite palatable, the flesh of the other mergansers being rank and fishy." The flesh of the Crane (most probably *Grus canadensis tabida* [Peters]), according to Zeisberger (65), "is dark, rather tough and seldom eaten by the Indians." They much more relished the flesh of the Wild Swans, for Zeisberger writes (66) that "the Indians declare that their flesh tastes like that of the bear, of which they are particularly fond, and is often so fat that pieces [of fat] may be cut from the flesh." The Loon, Zeisberger states (67), "is not eatable, but the Indians make pouches of its skin, which is taken off whole, large enough to hold pipe, tobacco, flint, steel and knife."

Zeisberger is quite definite (68) about having "found here," that is, in the Schönbrunn area, "one variety of snake" which he had "met with in no other region."

> "The belly is quite red. These serpents may be found in the water and on land. They get to be from five to six feet in length and their bite is poisonous. To cure the bite of this reptile the Indians use a plant that grows in the water. These snakes have teeth all around the mouth, above and below, but no fangs."

As far as the description goes, it clearly fits the Red-Bellied Water-Snake (*Natrix erythrogaster* Shaw); and it is evident that he did not intend to describe a venomous snake; that is, one, such as a rattlesnake, with fangs functioning like a hypodermic needle. In fact, he states expressly—and obviously from personal investigation—that the teeth, "above and below," are set "all around the mouth," and that there are "no fangs." Nevertheless he declares that "their bite is poisonous." At a first glance there seems to be an incongruity between the two statements. But there really is none, for Zeisberger does not say that it is a poisonous snake, but merely that "their bite is poisonous." Some herpetologists claim to possess observations on the toxic effect of watersnakes' saliva on persons bitten by them; while others are emphatic about there being nothing to it: they themselves as well as acquaintances of theirs had been bitten many a time by watersnakes without even a trace of a reaction. No one who is familiar with the facts of "selective toxicity" will declare either of the two observations incorrect. The truth in the matter apparently is that some persons show toxic reactions to the bite of watersnakes (Natrix, and related genera), and to that of *Natrix erythrogaster* Shaw, in particular, while others do not.

Zeisberger's reliability as an observing naturalist has been questioned on the grounds of a story he tells about a horse, bitten by a black snake, having died despite all possible efforts to save it. Of course, here he doubtless recorded a faulty observation: either the horse's death was due to another cause (possibly, the bite of a rattlesnake) while the Black-Snake just happened to be around; or, he related his story from hearsay but not from personal observation. Whatever its source may be, errors such as this occur in the records of all observers, be they naturalists or historians, and it would be unfair to discredit on their account a man's entire work, unless there is cogent evidence to an intent to defraud. Such an accusation could never be raised, even by malevolent critics, against Zeisberger who, in small matters, may have occasionally erred, though always in the best of faith. Whoever objectively and thoroughly studies his notes will increasingly gain the assurance of dealing with a source-book of high importance for historians in various fields.

One more reptile which Zeisberger comments upon is the Common Soft-Shelled Turtle (*Amyda spinifera* LeSueur) (69). After a concise description, he writes:

> "The Indians shoot them, for they are not easily caught in any other way, as they seldom venture out of the water upon the banks of the river. The Indians are very fond of the flesh and of the eggs which the animals lay in the sand on islands."

(II) The Lagoon and the River

Not entering upon a discussion of aquatic plants, Zeisberger (70) at once proceeds to list and describe the fishes of the area. Nowhere in his book does his integrity as an observing naturalist stand out more clearly than in the brief introductory paragraph to his ichthyological survey. It reads, as follows:

> "Of fishes, there are doubtless many more varieties than those I have seen in the Ohio. I will, however, confine notice to those I have seen and know."

What here he calls "the Ohio" apparently included, to his mind, those tributaries with which he was primarily concerned: the Muskingum and, especially, the Tuscarawas.

(a) *Aquatic Flora*

No water plants are discussed in Zeisberger's book: from the fact, however, that the Indian women made mats of "rushes which grow in ponds or stagnant water" (71); and also, of the leaves of Flag, or Cat-Tail (72), it may be inferred that these plants grew in the Tuscarawas area. The latter reference, from a Friedenshütten (Wyalusing) Diary, is validated, for the Tuscarawas region, by an entry (July 3, 1773) in a Gnadenhütten Mission Diary, which states that "some of the sisters went out to look for *Binsen* [rushes] for mats." The grasses used for the purpose were *Scirpus pungens* L. the Bulrush, and *Typha latifolia* L., the Cat-Tail (73).

(b) *Aquatic Fauna*

In addition to the Fishes there are to be included a very few species previously listed above, from the Reptile and Amphibian classes of vertebrates which never or rarely leave the water. Also to be included are the larva forms of all amphibians previously listed, as well as the larvae of the mosquitoes and gad-flies mentioned above (p. 62). Water birds are listed on pages 60–61.

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature*
Reptiles:		
The River Tortoise (see above, p. 61).....	**Trionyx spinifer* LeSueur, the Common Soft-Shell Turtle..	**Amyda spinifera* LeSueur
(*Descr.*:) "Watersnakes spend much time in the water, live on fish and are not poisonous".....	**Natrix fasciata sipedon* L.....	**Natrix sipedon sipedon* L.
Amphibians:		
(*Descr.*:) ". . . another variety of fish, or whatever one may call it, resembling a small catfish, but having four short legs." Etc., see above, p. 62.....	*Necturus maculatus* Rafinesque, The Water Dog with external gills; and **Cryptobranchus alleganiensis* (Daudin), the Hellbender, or Water Dog without external gills.....	*Necturus maculosus* Rafinesque (never leaves the water; **Cryptobranchus* does.—*A.C.M.*).
Fishes:		
"Pike are of uncommon size and generally known"	(*Note 231*): "*Stizostedion vitreum* Mitchill, the pike perch or jack salmon, etc."	*Esox masquihongiohioensis* Mitch.

*Also listed with the Fauna of the Swamp Forest Area, including the Lagoon and its littoral fringes. See above, p. 61.

Zeisberger's Name	*ZH Notes*	*Corrected Nomenclature*
The Black Fish.....	"probably *Moxostoma aureolum* (Le Sueur), the Common Red-Horse; or *Catostomus commersonii* (Lacepede), the White Sucker; or *Cycleptus elongatus* (Le Sueur), the Black-Horse."	
The Buffalo-Fish.....	. . . "several of genus *Ictiobus*, etc.".....	Error; the description fits the Sheep's Head, *Aplodinotus grunniens* Rafinesque; acc. to Mr. M. Trautman.
The Catfish.....	"Several species . . . in the Muskingum, *Ictalurus punctatus* Raf., the Blue Cat; *Ameiurus lacustris* Walbaum, the Mississippi Cat; *A. nebulosus* LeSueur, the Bull-Head; and *Leptops olivaris* Raf., the Mud-Cat."	*Ictalurus lacustris* Walbaum *Pilodictis olivaris* Rafinesque
The Sturgeon.....	*Acipenser rubicundus* LeSueur	*Acipenser scaphorhynchus platyrhynchus* Rafinesque; acc. to Mr. M. Trautman.
(*Descr.:*) ". . . fish with a narrowly formed mouth, armed with sharp teeth, almost like the bill of a duck".....	*Lepisosteus osseus* L., the Gar-Pike	
(*Descr.:*) ". . . another kind resembles the Cat-Fish very much. It has no scales . . . broad, plain beak like the bill of a goose, almost the length of a hand. This it uses to dig in sand and slime in search for food. The mouth opens below".....	*Polydon spathula* Walbaum, the Spoon-Bill Cat.	
"The White Perch is short and broad. It has scales and is good to eat".....	"*Aplodinotus grunniens* Rafinesque, the White Perch, also called Fresh-Water Drum . . . grunting or drumming noise."	Z.'s description too vague for identification, but *not Aplodinotus grunniens* Raf.; (see above, p. 65).
"The Yellow Perch . . . one of the most palatable fishes".....	*Perca flavescens* Mitchill.....	*Stizostedion vitreum* Mirch.
"Eels are rarely found"....	*Anguilla chrysypa* Rafinesque..	*Anguilla bostoniensis* LeSueur "possibly one of several species of lamprey" (Dr. Edward Thomas; *cf. ZH*, notes 63 and 241).
Molluscs: (*Descr.:*) "Two varieties of shell fish are found as well. One resembles the clams found along the sea coast, the inside of the shell being violet, shading to red; the other has a larger shell, which is white inside. Some specimens of smaller varieties are also found"	(*Note 245*): "There are many species of mussels occurring in the region, belonging to the genera, Unio, Anodonta, Lampsilis, etc.; the shells of several of these have a colored nacrous layer." "Other Unio species (?)"	

As remarked above the fish called "The Buffalo-Fish" by Zeisberger (74) is given a description which precisely fits the Sheep's Head. It is an especially fine example of its kind and reads as follows:

> "The buffalo-fish is thus called by Indians and Europeans because of its being heard sometimes to bellow in the water. Its length is about a foot and a half or even two feet and its breadth five or six inches. It has a curved back, prickly fins, a narrow mouth, and a small head in which two white stones are found flat on one side and a little convex on the other. These are not ordinary stones but have a stony appearance. The fish has no teeth, but at the entrance of its throat there are two strong flat bones, with grooves exactly fitting each other. With these it can crack the hardest mussels, which are its chief food, and serve to bait the hook in angling for it. The Indians, however, rarely using a hook and line, commonly pierce this fish with an iron prong of their own making. If any one should venture to put his finger into its mouth, even when to appearance it is half dead, he is in danger of losing one or more of his fingers, for the mussel shells which the fish constantly cracks are very hard."

In his description of the Sturgeon, Zeisberger remarks that it "is the largest of the fish in the Muskingum. The largest caught here were from three to three and a half feet in length." In view of this statement, one is surprised to read in the Schönbrunn Diary (75) that "the brethren went fishing today and caught several large fish, from four to five feet in length;" and again, under July 19, 1773, that, in a fine catch of fish, made that day, there were "some very large, from six to seven feet in length."

Of course, there are several possible explanations for this "fish story." Either, the fortunate Indian fishermen exaggerated shamefully to the recording Missionary (possibly Zeisberger himself) who somehow may have failed to inspect the catch with his own eyes; or, fish of that size were actually caught in those days. In the notes to Zeisberger's book the following quotation is found (76):

> "Judge Gilbert Devoll took a pike in the Muskingum which weighed nearly one hundred pounds, on the 2nd day of July, 1788. He was a tall man but when the fish was suspended on the pole of the spear from his shoulder, the tail dragged on the ground, so that it was about six feet in length. The enormous fish was served up on the 4th of July at a public dinner."

According to the editors of Zeisberger's History (77) "the pike" is not *Esox masquihongi ohioensis* Mitch., but *Stizostedion vitreum* Mitch. (currently called the White Perch), which they call "the pike perch or jack salmon." Thus it would appear that this fish was about the biggest of them all in the Muskingum, but not the Sturgeon, as claimed by Zeisberger. It is hard to decide which of these "fish stories," if any, is absolutely true.

REFERENCES

With abbreviations used in these pages

DFI—Deam, Charles C., *Flora of Indiana* (Indianapolis, 1940).

HJ—John Heckewelder's *Journal*, of 1792; contained in Heckewelder, John, *A Narrative of the Missions of the United Brethren among the Delaware and Mohegan Indians*. Ed. William E. Connelley (Cleveland, 1907).

SD (1-12)—Mission Diary, Schönbrunn (Ohio), Nos. 1-12. Mission reports periodically sent to the Moravian mother church, at Bethlehem, Pa., 1772–1777 (ms., Moravian Archives, Bethlehem, Pa.).

TMHS—Transactions of the Moravian Historical Society (Nazareth, Pa., 1858–76; 1876–, and Bethlehem, Pa., special series, since 1923).

ZH—Hulbert, Archer B., and Schwarze, William N. (ed.), *David Zeisberger's History of the Northern American Indians* (Columbus, Ohio: Ohio State Archaeological and Historical Society, 1910); reprinted from *Ohio State Archaeological and Historical Quarterly*, XIX (1910).

NOTE: The numerous text quotations from *ZH* are in the competent translation of the late Rev. Dr. William Nathanael Schwarze, former President of the Moravian College and Seminary, and, after his retirement, Director of the Moravian Archives, at Bethlehem, Pennsylvania.

Occasionally it was necessary to consult the German original of Zeisberger's work, a manuscript volume in the Moravian Archives, at Bethlehem.—*ACM.*

Check List of American Birds, 4th edition (*A.O.U.*; Lancaster, Pa., 1931).

NOTES

(1) *ZH*, p. 7.
(2) *Ibid.*
(3) 2 Vols., 1768.
(4) *ZH*, p. 47.
(5) pp. 154–173.
(6) For scholarly help and advice I am indebted to Dr. Edward S. Thomas, Curator of Natural History, Ohio State Museum; Professors Edgar N. Transeau and John N. Wolfe, Department of Botany, The Ohio State University; and Mr. Milton B. Trautman, Research Associate (Ichthyology), Franz Theodore Stone Laboratory, Put-in-Bay, Ohio.—*ACM.*
(7) *ZH*, p. 47.
(8) My own translation from the German original; *ZH*, p. 47, reads, "The forests contain mainly oak trees;" *ACM.*
(9) *Busch;* rather unusual for the more common *Wald. ACM.*
(10) *Ibid.*
(11) *ZH*, p. 51.
(12) *ZH*, p. 163, n. 127.
(13) *ZH*, p. 46.
(14) *ZH*, p. 56f.
(15) *ZH*, p. 48.
(16) *ZH*, p. 57ff., and *passim.*
(17) *ZH*, p. 64.
(18) *ZH*, p. 57.
(19) *ZH*, p. 14.
(20) *ZH*, p. 57f.
(21) *ZH*, p. 59.
(22) *ZH*, p. 59f.
(23) *ZH*, p. 60f.
(24) *ZH*, p. 62.
(25) *ZH*, p. 64.
(26) *Ibid.*
(27) *ZH*, p. 66.
(28) *Ibid.*
(29) *Ibid.*; translation slightly modified.—*ACM.*
(30) *ZH*, p. 166, n. 189.
(31) "Report on the Birds of Ohio," *Rep. Geol. Survey of Ohio*, IV (1882), Pt. I, p. 499.
(32) *ZH*, p. 66.
(33) *ZH*, p. 69; in the German manuscript of Zeisberger's book (*Moravian Archives*, Bethlehem, Pa.), the name of the bird is "*die Amsel*," unmistakably the [European] Black-bird (*Turdus merula* L.); *ACM.*
(34) *ZH*, p. 167, n. 209.
(35) *ZH*, p. 70; the beginning of the description, in *ZH*, quoted below, has been slightly modified according to the original German.—*ACM.*
(36) *ZH*, p. 71.
(37) *ZH*, p. 168, n. 224.
(38) *ZH*, p. 71.
(39) *ZH*, p. 72.—Quoted in my own translation since *ZH*, here, is not accurate.—*ACM.*
(40) *Ibid.*—*ZH* translation modified.—*ACM.*
(41) *ZH*, p. 74.
(42) *ZH*, p. 72.
(43) *ZH*, p. 72f.
(44) *Ibid.*
(45) *ZH*, p. 74f.
(46) *ZH*, p. 152.
(47) *Ibid.*
(48) *ZH*, p. 173, n. 318.
(49) *HJ, 1792*, p. 60f.
(50) *ZH*, p. 47.
(51) *ZH*, p. 57.

(52) *ZH*, p. 52.
(53) *ZH*, p. 46.
(54) *ZH*, p. 153.
(55) *ZH*, p. 47.
(56) *ZH*, p. 153.
(57) *ZH*, p. 57f.
(58) *ZH*, p. 61f.
(59) Zeisberger did not have to go far afield for his observations on beavers and beaver dams. A creek in the immediate vicinity of Schönbrunn, even on modern maps, bears the name of Beaverdam Creek.—*A CM.*
(60) *ZH*, p. 164, n. 160.
(61) *ZH*, p. 63.
(62) *ZH*, p. 65.
(63) *Ibid.*
(64) *ZH*, p. 165, n. 181.
(65) *Ibid.*
(66) *ZH*, p. 65f.
(67) *ZH*, p. 66.
(68) *ZH*, p. 71.
(69) *ZH*, p. 74.
(70) *ZH*, p. 73.
(71) *TMHS*, Vol. I, p. 192.
(72) *Ibid.*
(73) *Ibid.*
(74) *ZH*, p. 73.
(75) *SD 5*, July 9, 1773.
(76) *ZH*, p. 169, n. 231, citing S. P. Hildreth, *Pioneer History*, etc. (Cincinnati & New York, 1848), p. 498.
(77) *Ibid.*

Chemical Insect Attractant and Repellents

The author presents a clear, concise and well-organized volume on a subject heretofore appearing only as papers in a wide variety of publication outlets.

The book begins with a chapter on the historical background of repellents and attractants. This is followed by chapters on: Nature of Chemical Attractants, Essential Oils, Resins and Related Substances; Fermentation Products; Protein and Fat Decomposition Products; Olfactometers and Threshold Concentrations; Baits and Traps; Repellents; Chemical Basis of Taste and Olfaction; and Evolution of Feeding Preferences. An author index and subject index completes the book. Following each chapter is a large list of citations from scientific journals.

This book fills an important gap in the literature of scientific entomology by making readily available the fundamentals of this important subject.—*R. H. Davidson.*

Chemical Insect Attractants and Repellents, by Vincent G. Dethier. 289 pages, 69 figures. The Blakiston Company, Philadelphia, Pa. 1947. Price $5.00.

THE NATURAL OCCURRENCE OF "REDLEG," PSEUDOMONAS HYDROPHILA, IN A POPULATION OF AMERICAN TOADS, BUFO AMERICANUS

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The natural occurrence of an epidemic of "Redleg," *Pseudomonas hydrophila* (Chester), in a population of American Toads, *Bufo americanus* Holbrook, seemed significant for two reasons: 1) to the writer's knowledge it is a new naturally occurring host record; and 2) it showed how easily disease is overlooked in the casual observations made by many biologists.

It was purely by chance that the epidemic was discovered. On March 22, 1948, George H. Breiding and the writer visited the lower of two small ponds in lower Donnelly Hollow near Charleston, West Virginia. There a large population of American Toads was observed and estimated to be about 300 individuals. The toads were mating and were very actively clasping. They seemed very tame and could easily be picked up. The writer returned the following day to make some photographs of the toads and found the population reduced to about two dozen individuals. Many dead toads were seen on the bottom of the pond and on the shore where they had crawled from the water and died.

None of the specimens examined showed any mark of violence. On March 24, only three pairs of living toads were found and an additional number were found dead. The only remaining pair was collected on March 25. This pair had been observed for several days. It was unique in that the female was dead when the pair was first observed, on March 23, but the male continued clasping until separated four days later, after being transported to the Ohio State University at Columbus, Ohio.

The following day the male died. External symptoms and bacteriological tests proved that the disease was "Redleg."

The site of the epidemic was visited again on April 24, 1948. Water samples were taken at both ponds and at three stations two-tenths of a mile apart in the stream which flows from the ponds. Blood samples and smears were made from one specimen each of Spotted Newt, *Triturus v. viridescens*, Pickerel Frog, *Rana pipiens*, and an American Toad tadpole taken from the upper pond and from one specimen of an American Toad tadpole and two Spotted Newts taken from the lower pond.

Tests showed that from the upper pond, only the tadpole contained *Pseudomonas hydrophila;* two water samples and one Newt from the lower pond contained the bacillus; and that the three water samples taken at the stations along the stream were all infected.

Bacteria from each positive culture were injected into toads which died subsequently and from whose heart blood *Pseudomonas hydrophila* was then recovered.

A limited amount of laboratory experimentation was done in which specimens of American Toads and Spotted Newts were placed in aquaria containing water contaminated with *Pseudomonas hydrophila*. No disease specimens resulted. The animals were then injured slightly to provide a means of entry for the bacteria. This resulted in contraction of the disease by the toads but not in the newts.

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From the foregoing, it was concluded that "Redleg" occurs in nature in American Toads. This occurrence would probably only come about during the breeding season during which toads are found in water, the natural habitat of *Pseudomonas hydrophila*, and also the period during which their activity in clasping provides the abrasions which permit the entry of the bacillus into the blood stream.

The experimentation might also indicate that the Spotted Newt is an immune species and a carrier of "Redleg." However, too little data have been collected to make this a positive assertion.

A point of importance is the ease at which this epidemic could have occurred unnoticed had not the pond been visited several days in succession. Certainly many similar and many more lesser epidemics of disease frequently occur unnoticed in nature. The cases observed and reported are probably, for the most part, chance records as was this one.

DISCOVERY OF LIVING METASEQUOIA

SAVE-THE-REDWOODS LEAGUE[1]

The genus *Metasequoia* is a conifer which was widely distributed over the northern hemisphere in past ages. Its fossil remains (wood, leaves, cones) have been found in Alaska, Greenland, Spitzbergen and northern Siberia, in rocks of Eocene age (60,000,000 years old); in rocks of Miocene age (30,000,000 years old) in Oregon and California, Germany and Switzerland, Manchuria and Japan. It was considered to have become extinct, some 20,000,000 years ago, since its fossil remains did not occur in rocks younger than Miocene.

About two years ago, reports came from China of the discovery of three trees of *Metasequoia* in a village in the interior. One of these living trees was described as large, but no photographs were available, nor was it possible to find out much about it. In order to establish the accuracy of this report, and to learn the true nature of these trees, Ralph W. Chaney, paleobotanist of the University of California and the Carnegie Institution of Washington, and Milton Silverman, Science Editor of the San Francisco "Chronicle", left San Francisco by Pan American World Airway plane in February, bound for Shanghai and Chungking; from this former capital of China, they proceeded down the Yangtse on a riverboat to Wan Hsien. Here they secured baggage porters and sedan chairs, and set out on a journey southward more than a hundred miles into the provinces of Szechuan and Hupeh. Traveling over a path largely made up of a rock slab stairway, they covered from 20 to 30 miles a day in rain and fog—a path which crossed four mountain ranges of which two were over 5000 feet high. This is a region seldom visited by foreigners—in fact, the remote village at the end of the journey had never before been entered by a foreign visitor. The reported presence of hundreds of bandits made necessary extreme precautions to prevent theft of cameras and other essential equipment; an armed guard was necessary during most of the journey.

[1]Based on a statement by Dr. Ralph W. Chaney, Professor of Paleontology, University of California, Berkeley; Chairman, Save-the-Redwoods League's Education and Interpretation Committee, 114 Sansome St., San Francisco 4, California.

"Just outside the village of Mo-tao-chi, 70 miles south of Wan Hsien", says Dr. Ralph W. Chaney, "we came upon the first trees of Metasequoia. The largest is nearly 100 feet tall, and 68 inches in diameter above the buttress (almost 11 feet in diameter where the buttress flares out at ground level). It has large branches which extend upward instead of turning downward as in the living redwood; another difference is that *Metasequoia* sheds its leaves in winter, so it was bare at the time of our visit; its bark has a reddish tone suggestive of the redwood, but is much thinner than that of the American tree. These and other differences readily distinguish *Metasequoia* from *Sequoia*, but a relationship between the two trees is at once apparent from the similarity of their cones, and their wood is also much the same. Preliminary examination indicates that *Metasequoia* may represent the ancestor of the American *Sequoia*.

"Continuing southward some 35 miles, we came into a valley occupied by over a hundred trees of *Metasequoia*. While none of these are as large as the giant tree at Mo-tao-chi, they are growing on slopes which have not been fully logged off, as is the case farther north. Here we were able to study the dawn redwood (*Metasequoia*) under essentially native conditions. It grows best beside streams or elsewhere in wet soil; it is not found at elevations far above 4000 feet, for it appears to require mild winter temperature. Its associates in the forest are chestnut, sweet gum, oak and birch, all of which trees grow today in many parts of the United States. In addition, there lives with *metasequoia* a large tree known as katsura which is confined to northeastern Asia at present. All these associates of the living *Metasequoia* had ancestral species growing with the fossil *Metasequoia* in western North America and Europe during the geologic past. Here we have a segment of yesterday—a forest which has miraculously survived destruction for a score of million years.

"How much longer will *Metasequoia* continue to exist in this central Asian sanctuary? An answer to the question is difficult to give, for in this land of fuel and timber shortage, these great trees of the past are rapidly being cut down by Chinese farmers. Some steps must be taken at once if *Metasequoia* is to be saved from extinction during our lifetime, if it is to continue to live on earth as one of the oldest, if not the most ancient forest tree in existence. At some time in the near future, an announcement will be made of the plans being made to preserve the *Metasequoia* of Tiger Valley from destruction."

Dr. Chaney and Dr. Silverman have recently returned to California with specimens of the wood, bark, leaves and cones of these remarkable trees, and with many scientific data which may be expected to aid in solving some of the problems surrounding the age-long survival of these Chinese ancestors of the California redwood.

VALIDITY OF THE SPECIFIC GRAVITY METHOD FOR THE DETERMINATION OF THE FINENESS OF GOLD OBJECTS

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The determination of the gold content or fineness of gold objects by means of specific gravity measurements is one of the oldest known methods of assay. The account given by Vitruvius of the way by which Archimedes detected the adulteration of the gold in the crown of Hieron of Syracuse shows that the method was known in principle, even if not widely used, before the beginning of the Christian Era. There is evidence from Arab sources that it was used in the Middle Ages, and the accounts of the method given in works on assaying of the sixteenth and seventeenth centuries indicate that it was in common use in early modern times. It is still used occasionally for the determination of the fineness of gold objects which cannot be assayed or analyzed by the usual dry or wet methods. Indeed, the great and unique value of the method is that it makes possible an estimate of the fineness of gold objects, which, because of their great antiquarian or artistic value, cannot be sampled in any way, even for micro-analysis. In spite of the long time this method has been in use and in spite of its undoubted special value, no critical estimate of its probable accuracy or limitations, apart from brief statements, appears ever to have been published. There is considerable evidence that various workers have used this method uncritically and attributed to it an unwarranted degree of accuracy. For example, Giesecke (4) determined the specific gravities of a number of ancient electrum coins and then calculated their gold content in two decimal places in percent. It can easily be shown that the method does not warrant expressing results to such an apparent degree of accuracy. The purpose of the present paper is to indicate its probable degree of accuracy and its limitations.

A primary difficulty in the determination of the composition of alloys of gold and silver, or of gold and copper, by specific gravity measurements is that the specific gravities of the pure metals themselves cannot be defined with any high degree of precision. Results of even very careful measurements of this so-called constant have varied considerably in accordance with the mechanical and thermal history of the specimens studied. Mellor (11) has ably summarized the discordant results obtained by different workers. Though the lack of agreement is less when only the most reliable results on massive specimens are considered, and still less when mechanically worked metal is alone considered, this being of more practical significance in connection with the kinds of objects ordinarily assayed by the specific gravity method, there is nevertheless apparently no justification for expressing the specific gravities of the pure metals to more than a single decimal place for the purpose of computing the composition of their alloys. This means that as a basis for determination carried out at or close to 25° C. with reference to the density of water at 4° C. the specific gravity of gold should be taken as 19.3, that of silver as 10.5, and that of copper as 8.9. Hence it follows that for the determination of the composition of gold-silver alloys with a possible range of 0 to 100 percent for either component, there are actually available from the difference between the specific gravities of the two metals only 88 possible units in the scale of measurement, each of these units being a tenth of a unit in specific gravity. On the average, therefore, a little more than one percent is the closest approach that can possibly be attained in respect to the composition of

such alloys by this method. Actually if no contraction or expansion occurs on alloying, each tenth of a unit in specific gravity represents a little more than half a percent change in composition near the top of the range in gold content and about two percent change near the bottom of the range. Likewise for gold-copper alloys there are only 104 possible units in the scale of measurement, and on the average slightly less than one percent is the closest possible approach to composition that can be attained, with approximately the same differences at the extremes as with gold-silver alloys if no change in volume occurs on alloying. These differences at the extremes of the ranges necessarily follow from the nature of the ideal proportional relationship between specific gravity and percentage composition by weight of such binary alloys. This relationship may be expressed by the following convenient formula:

$$\% \text{ Gold} = \frac{S_1 S_x - S_1 S_2}{S_1 S_x - S_2 S_x} \cdot 100$$

Where, on the same temperature basis for each,

S_1 is the specific gravity of pure gold.
S_2 is the specific gravity of pure silver or of pure copper.
S_x is the specific gravity of a given alloy.

A comparison between the ideal figures as computed by the above formula and the experimental figures obtained by various investigators also shows that

TABLE I

Comparison Between Actual Gold Content of Gold-Silver Alloys and Their Gold Content as Calculated from Their Specific Gravities

Specific Gravity	Gold Content from Specific Gravity	Actual Gold Content	Difference	Literature Reference
	%	%	%	
19.28	99.9	99.7	+0.2	6
19.17	99.2	99.5	−0.3	6
18.08	91.9	91.7	+0.2	8
18.04	91.6	91.6	±0.0	10
17.93	90.9	91.7	−0.8	6
17.54	88.0	88.0	±0.0	10
16.96	83.6	84.3	−0.7	8
16.35	78.5	78.5	±0.0	10
16.03	75.6	75.0	+0.6	8
15.07	66.5	66.7	−0.2	8
14.87	64.6	64.6	±0.0	10
14.24	57.6	58.3	−0.7	8
13.60	50.0	50.0	±0.0	8
13.43	47.9	47.8	+0.1	10
13.00	42.2	41.7	+0.5	8
12.38	33.3	33.3	±0.0	8
12.26	31.5	31.4	+0.1	10
11.78	23.8	25.0	−1.2	8
11.76	23.5	23.4	+0.1	10
11.29	15.3	16.7	−1.4	8

NOTES ON ORIGINAL DATA

Reference 6. The gold content is given in carats and grains, and the specific gravity to three decimal places.

Reference 8. The gold content is given in parts per thousand, and the specific gravity as shown.

Reference 10. The gold content is given by formula, e.g., Ag_4Au, and the specific gravity to three decimal places.

the method is not any more reliable than about one percent even under the best experimental conditions. In Tables I and II are shown comparisons of figures from what appear to be the most careful experiments on record with corresponding ideal figures for gold-silver and gold-copper alloys. In order to show up distinctly the differences between the ideal figures and the experimental figures, the specific gravity of gold for this special purpose was taken as 19.30, that of silver as 10.50, and that of copper as 8.90 when calculating the ideal figures from the measured specific gravities, and the ideal gold content is correspondingly given to the first decimal place. As explained in the footnotes to these tables, most of the experimental figures were obtained by appropriate recalculation of the original published data so as to place all the figures on a uniform basis for the purpose of easy comparison. However, no corrections have been made for the differences in the

TABLE II

Comparison Between Actual Gold Content of Gold-Copper Alloys and Their Gold Content as Calculated from Their Specific Gravities

Specific Gravity	Gold Content from Specific Gravity	Actual Gold Content	Difference	Literature Reference
	%	%	%	
18.84	97.9	98.0	−0.1	13
18.58	96.7	96.9	−0.2	13
18.36	95.6	95.8	−0.2	13
18.12	94.4	94.8	−0.4	13
17.93	93.5	93.9	−0.4	13
17.79	92.7	93.2	−0.5	13
17.57	91.6	92.3	−0.7	13
17.35	90.4	91.7	−1.3	8
17.17	89.4	90.1	−0.7	13
16.81	87.4	88.1	−0.7	13
16.48	85.4	86.1	−0.7	13
15.86	81.5	83.3	−1.8	8
14.74	73.5	75.0	−1.5	8
12.69	55.4	58.3	−2.9	8
10.04	21.0	25.0	−4.0	8

NOTES ON ORIGINAL DATA

Reference 8. The gold content is given in parts per thousand, and the specific gravity as shown.

Reference 13. The gold content is given to two decimal places in percent. Three experimental results are given for the specific gravity of each alloy, and the average of these to four decimal places.

temperatures at which the specific gravities were measured since the lack of uniformity in this respect apparently would not be enough to affect the first decimal place in the calculated percentages of gold. The figures in Table I were all derived from measurements on cast alloys, with the exception of those of the first line, so that there is probably a reasonable degree of uniformity in the physical condition of the gold-silver alloys here compared. From this table it is evident that for gold-silver alloys the agreement between the calculated and the actual percentages of gold is fairly good throughout the whole range of composition. Nevertheless, individual deviations amounting to around one percent are by no means uncommon. From Table II it is evident that for gold-copper alloys the agreement throughout the whole range of composition is not good. In part this may be because the measurements of one of the investigators were made on worked alloys, and the other on cast alloys. However, if the results on the worked alloys are alone considered (Reference 13), individual deviations approaching one percent are still

common. A more important cause of the general lack of agreement is that when gold is alloyed with copper a change in total volume occurs, this increasing as the proportion of copper in the alloy increases, so that the ideal formula does not strictly apply. However, even if a correction is made for this change in volume, individual deviations of around one percent still occur, so that here again the method is not consistently reliable to more than about one percent even under the most favorable conditions.

When this method is used for estimating the gold content of actual objects of unknown composition the error may often far exceed one percent for any of various reasons. In the first place the mechanical and thermal history of a given object is often unknown so that it may not be easy to determine whether the object is worked or cast. More serious is the possible presence of foreign inclusions in the metal, and worse yet the possible presence of hidden cavities. Another serious source of error may be a lack of knowledge of the particular metals alloyed with

TABLE III

MAGNITUDE OF POSSIBLE ERROR WHEN ALLOYING COMPONENT IS UNKNOWN

Observed Specific Gravity	Calculated Gold Content if Silver is Assumed to be the Sole Alloying Component %	Calculated Gold Content if Copper is Assumed to be the Sole Alloying Component %	Difference in Calculated Gold Content %
19.20	99.4	99.6	0.2
19.00	98.1	98.6	0.5
18.80	96.8	97.7	0.9
18.60	95.5	96.8	1.3
18.40	94.2	95.8	1.6
18.20	92.8	94.8	2.0
18.00	91.4	93.8	2.4
17.80	89.9	92.8	2.9
17.60	88.5	91.7	3.2
17.40	87.0	90.7	3.7
17.20	85.4	89.6	4.2
17.00	83.9	88.4	4.5
16.80	82.2	87.3	5.1
16.60	80.6	86.1	5.5
16.40	78.9	84.9	6.0
16.20	77.2	83.6	6.4
16.00	75.4	82.4	7.0

the gold. The presence of platinum or other heavy metals of the platinum group, for example, would lead to deceptively high results, though this cannot be considered a common source of error. More commonly, if the gold is alloyed with copper alone and it is assumed that it is alloyed with silver, or vice versa, or more commonly still, if it is alloyed with both in some unknown proportion and the assumption is made that it is alloyed with one or the other only, serious errors may arise in the estimation of the gold content of the metal from the observed specific gravity. The possible extent of this error from this one important source alone is indicated by the differences in the computed ideal results shown in Table III. It will be noted that this source of error is not serious for alloys of very high gold content, but that it becomes increasingly serious with decrease in gold content.

Since a considerable number and variety of natural and artificial gold objects have been assayed or analyzed by standard dry or wet assay methods by previous investigators, who at the same time carefully measured the specific gravity of these objects, the degree of error from all sources likely to be encountered in actual

practice may be approximated by an examination of their results. Curiously enough, only thirteen examples could be found where the investigator, himself, had estimated the gold content from the specific gravity and compared the result with the actual content found by analysis or assay. For most of the collected examples shown in Table IV, therefore, the gold content has been computed from

TABLE IV

COMPARISON OF GOLD CONTENT OF VARIOUS NATURAL AND ARTIFICIAL OBJECTS AS ESTIMATED FROM SPECIFIC GRAVITY WITH THEIR GOLD CONTENT AS DETERMINED BY ANALYSIS

No.	Description	Specific Gravity	Gold Content from Specific Gravity on Given Basis, %			Gold Content by Analysis %	Difference Error on Given Basis, %			Literature Reference
			A	B	C		A	B	C	
1	Nugget	19.10	98.8	99.1	99.0	99.0	−0.2	+0.1	±0.0	14
2	Ancient Ornament	19.10	98.8	99.1	99.0	98.0	+0.8	+1.1	+1.0	15
3	Natural Crystal	18.77	96.6	97.6	97.2	95.4	+1.2	+2.2	+1.8	1
4	Nugget	18.67	96.0	97.1	96.6	94.2	+1.8	+2.9	+2.4	3
5	Ancient Wires	18.59	95.4	96.7	96.2	96.9	−1.5	−0.2	−0.7	9
6	Nugget	18.44	94.4	96.0	95.4	94.4	±0.0	+1.6	+1.0	14
7	Native Grains	18.31	93.6	95.4	94.6	94.7	−1.1	+0.7	−0.1	3
8	Natural Crystal	18.11	92.1	94.4	93.5	92.5	−0.4	+1.9	+1.0	1
9	Ancient Bar	18.05	91.7	94.1	93.1	90.7	+1.0	+3.4	+2.4	16
10	Nugget	17.96	91.1	93.6	92.6	91.4	−0.3	+2.2	+1.2	14
11	Nugget	17.84	90.2	93.0	91.9	93.5	−3.3	−0.5	−1.6	3
12	Nugget	17.59	88.4	91.7	90.3	90.8	−2.4	+0.9	−0.5	14
13	Fragment of Ancient Ornament	17.53	87.9	91.4	89.9	88.6	−0.7	+2.8	+1.3	9
14	Nugget	17.48	87.5	91.1	89.6	89.4	−1.9	+1.7	+0.2	14
15	Nugget	17.40	87.0	90.7	89.1	87.4	−0.4	+3.3	+1.7	14
16	Ancient Plate	17.33	86.4	90.3	88.7	88.7	−2.3	+1.6	±0.0	9
17	Celtic Ring Money	17.26	85.9	89.9	88.2	86.7	−0.8	+3.2	+1.5	9
18	Celtic Ring Money	16.90	83.1	87.8	85.9	85.6	−2.5	+2.2	+0.3	9
19	Nugget	16.87	82.9	87.7	85.7	86.8	−3.9	+0.9	−1.1	14
20	Fragment of Ancient Torque	15.69	72.5	80.3	77.1	71.0	+1.5	+9.3	+6.1	15
21	End of Ancient Bracelet	15.50	70.7	79.0	75.6	75.6	−4.9	+3.4	±0.0	15
22	Fragment of Ancient Torque	15.44	70.2	78.6	75.1	79.5	−9.3	−0.9	−4.4	9
23	Ancient Bosses	15.43	70.1	78.5	75.0	74.7	−4.6	+3.8	+0.3	15
24	Fragment of Ancient Torque	15.38	69.6	78.2	74.6	71.5	−1.9	+6.7	+3.1	9
25	Ancient Coin	15.06	66.4	75.9	72.0	69.0	−2.6	+6.9	+3.0	2
26	Ancient Bar	14.83	64.0	74.2	70.0	66.8	−2.8	+7.4	+3.2	16
27	Ancient Coin	14.35	58.8	70.5	65.6	59.8	−1.0	+10.7	+5.8	7
28	Ancient Coin	14.04	55.3	67.9	62.7	69.7	−14.4	−1.8	−7.0	2
29	Ancient Coin	13.85	53.0	66.3	60.8	59.5	−6.5	+6.8	+1.3	2
30	Ancient Coin	13.66	50.7	64.7	58.9	57.9	−7.2	+6.8	+1.0	5
31	Ancient Coin	13.23	45.3	60.7	54.3	57.3	−12.0	+3.4	−3.0	16
32	Ancient Coin	13.07	43.1	59.2	52.5	51.8	−8.7	+7.4	+0.7	16
33	Ancient Coin	12.19	30.4	50.1	41.9	37.9	−7.5	+12.2	+4.0	2

the specific gravity and compared with the actual gold content for the first time. All previous investigators who calculated the gold content from the observed specific gravity did so on the assumption that the gold was alloyed with silver alone. But it can be shown that this assumption does not provide the best general basis for estimating the gold content of objects in which the nature and proportion of

the alloying metal or metals are unknown. It is true that in natural objects of very high gold content, or in objects fashioned from such native gold, silver is often the sole alloying metal, but for such objects of lower gold content copper may also be present in a proportion approaching that of the silver, and sometimes the copper is in higher proportion than the silver. For example, Object No. 5 of Table IV was found by the analyst to contain 2.49% silver and only a trace of copper, whereas Object No. 21 was found to contain 13.03% silver and 11.61% copper, and Object No. 23 to contain 6.22% silver and 19.09% copper. In objects formed from artificial alloys copper is still more likely to be present in high proportion when the gold content is low. It is therefore important to make some allowance for the possible presence of copper in considerable proportion when computing the gold content of objects of low fineness from specific gravity measurements.

As shown in Table IV, the gold content of the various objects has been calculated from the observed specific gravities on three different bases in order to find out empirically the best single general basis for such estimations. For Basis A the

TABLE V

ANALYSIS OF DATA OF TABLE IV SHOWING DIFFERENCES IN ACCURACY THAT RESULT FROM THE PARTICULAR BASIS SELECTED FOR COMPUTING FINENESS FROM SPECIFIC GRAVITY

Kind of Difference	Range of Actual Gold Content—%	Basis A	Basis B	Basis C
Proportion of Results Nearer to True Value.	Over 95	60%	20%	20%
	Under 95, over 90	57%	14%	29%
	Under 90, over 85	43%	14%	43%
	Under 85	36%	14%	50%
Average Error	Over 95	+0.4%	+1.2%	+0.9%
	Under 95, over 90	−0.9%	+1.5%	+0.5%
	Under 90, over 85	−1.8%	+2.2%	+0.6%
	Under 85	−6.1%	+5.9%	+1.0%
Greatest Single Error.	Over 95	+1.8%	+2.9%	+2.4%
	Under 95, over 90	−3.3%	+3.4%	+2.4%
	Under 90, over 85	−3.9%	+3.3%	+1.7%
	Under 85	−14.4%	+12.2%	−7.0%

assumption is that the gold was alloyed with silver alone, for Basis B that it was alloyed with copper alone, and for Basis C that it was alloyed with equal proportions of silver and copper, all computations being made according to the ideal mixture formula previously given. A slight uncertainty exists in these calculated results since some of the investigators did not state the temperatures at which the specific gravities were measured, and others measured them at different stated room temperatures. However, as found by test calculations, this lack of uniformity in the specific gravity figures can have little effect on the validity of the conclusions.

The actual figures for the gold content and the difference error on the three different bases are shown in Table IV, and in Table V a comparative summary of the resulting differences in accuracy is given. It will be seen that when the gold content is very high Basis A yields the best results, but that this same basis yields poor results on objects of low gold content. Basis B gives the poorest results when the gold content is high, and results that are nearly as poor as with basis A when the gold content is low. Basis C yields results on objects of very high gold content that are fairly good, and results on objects of lower gold content that are much better than either Basis A or Basis B. It is evident from all these figures that, of the three, Basis C is the best to use for objects of unknown composition.

Of course where the alloying metal is known from qualitative tests to be solely or predominantly silver or copper then Basis A or Basis B should be used. Still closer results on objects of unknown composition and of medium to high gold content might be obtained by selecting as a general basis for computation an ideal alloy having a higher proportion of silver than copper, or by using Basis A for objects of very high specific gravity and Basis C for objects of lower specific gravity, but in view of the approximate nature of the results anyway it is doubtful whether much would be gained by introducing such further refinements. Table VI, computed on Basis C, provides a convenient means for converting the observed specific gravity to percentage of gold when estimating the gold content of objects by this method.

TABLE VI

PRACTICAL CONVERSION TABLE FOR ESTIMATING GOLD CONTENT OF OBJECTS FROM SPECIFIC GRAVITY MEASUREMENTS

Specific Gravity 25°/4°	Gold Content %	Specific Gravity 25°/4°	Gold Content %	Specific Gravity 25°/4°	Gold Content %
19.3	100	16.5	83	13.7	59
19.2	99	16.4	82	13.6	58
19.1	99	16.3	82	13.5	57
19.0	98	16.2	81	13.4	56
18.9	98	16.1	80	13.3	55
18.8	97	16.0	79	13.2	54
18.7	97	15.9	79	13.1	53
18.6	96	15.8	78	13.0	52
18.5	96	15.7	77	12.9	51
18.4	95	15.6	76	12.8	49
18.3	95	15.5	76	12.7	48
18.2	94	15.4	75	12.6	47
18.1	93	15.3	74	12.5	46
18.0	93	15.2	73	12.4	45
17.9	92	15.1	72	12.3	43
17.8	92	15.0	71	12.2	42
17.7	91	14.9	71	12.1	41
17.6	90	14.8	70	12.0	39
17.5	90	14.7	69	11.9	38
17.4	89	14.6	68	11.8	37
17.3	89	14.5	67	11.7	35
17.2	88	14.4	66	11.6	34
17.1	87	14.3	65	11.5	32
17.0	87	14.2	64	11.4	31
16.9	86	14.1	63	11.3	29
16.8	85	14.0	62	11.2	28
16.7	84	13.9	61	11.1	26
16.6	84	13.8	60	11.0	25

It is further evident from Tables IV and V that the method is only reliable for objects of high gold content, and that it becomes increasingly less reliable as the gold content decreases until it becomes very unreliable indeed for objects of low gold content. The average error with objects of high gold content approaches one percent, and the error on single determinations may be around two percent, so that even for these the method should be regarded as no more than roughly quantitative. From the large errors likely to occur with objects of low gold content it is evident that for these this method yields only a rough estimate of the true gold content.

On the basis of all the foregoing considerations there is no point, therefore,

in attempting to determine the specific gravity of objects to more than the first decimal place for the purpose of estimating their gold content by this method, nor is there any point in expressing the results to more than the nearest whole number in percent. Furthermore, the method should be restricted to objects of a high degree of fineness.

TABLE VII

ESTIMATIONS OF THE FINENESS OF SOME ANCIENT GOLD COINS

No.	Place of issue	Ruler	Approximate Date of Coin	Denomination of Coin	Specific Gravity	Gold Content %
1	Persia	?	4th Cent. B.C.	Daric	19.0	98
2	"	?	4th Cent. B.C.	"	18.9	98
3	Macedon	Philip II	359–336 B.C.	Stater	19.2	99
4	"	Alexander III	323 B.C.	"	19.1	99
5	Carthage	?	277–219 B.C.	"	13.4	56
6	"	?	277–219 B.C.	"	13.3	55
7	Roman Republic	Julius Caesar	46 B.C.	Aureus	19.2	99
8	Roman Empire	Augustus	8 B.C.	"	19.1	99
9	" "	Tiberius	14–15 A.D.	"	19.2	99
10	" "	Tiberius	16–21 A.D.	"	19.2	99
11	" "	Tiberius	21–25 A.D.	"	19.2	99
12	" "	Claudius	49–50 A.D.	"	19.2	99
13	" "	Nero	64–68 A.D.	"	19.2	99
14	" "	Nero	64–68 A.D.	"	19.2	99
15	" "	Vespasian	69–79 A.D.	"	19.1	99
16	" "	Titus	74 A.D.	"	19.1	99
17	" "	Domitian	79 A.D.	"	19.1	99
18	" "	Domitian	84 A.D.	"	19.1	99
19	" "	Trajan	100 A.D.	"	19.2	99
20	" "	Hadrian	117 A.D.	"	19.0	98
21	" "	Hadrian	119–122 A.D.	"	19.1	99
22	" "	Hadrian	134–138 A.D.	"	19.1	99
23	" "	Antoninus Pius	143–144 A.D.	"	19.1	99
24	" "	Antoninus Pius	151–152 A.D.	"	19.2	99
25	" "	Antoninus Pius	156–157 A.D.	"	19.1	99
26	" "	Verus	163–164 A.D.	"	19.1	99
27	" "	Verus	163–164 A.D.	"	19.1	99
28	" "	Verus	163–164 A.D.	"	19.2	99
29	" "	Septimus Severus	193 A.D.	"	19.0	98
30	" "	Macrinus	217–218 A.D.	"	19.1	99
31	" "	Maximianus	286 A.D.	"	19.1	99
32	" "	Maximianus	288–289 A.D.	"	18.7	97
33	" "	Diocletian	287 A.D.	"	19.1	99
34	" "	Diocletian	290–292 A.D.	"	19.0	98
35	" "	Diocletian	296 A.D.	"	19.1	99
36	" "	Diocletian	296 A.D.	"	19.2	99
37	" "	Constantius II	337–361 A.D.	Solidus	18.8	97
38	" "	Constantius II	337–361 A.D.	"	18.4	95
39	" "	Jovian	363–364 A.D.	"	18.3	95
40	" "	Valentinian I	364–375 A.D.	"	19.0	98
41	" "	Valentinian I	364–375 A.D.	"	18.2	94
42	" "	Valens	364–378 A.D.	"	18.5	96
43	" "	Valens	364–378 A.D.	"	18.4	95
44	" "	Gratian	375–383 A.D.	"	19.1	99
45	" "	Theodosius	379–395 A.D.	"	19.0	98
46	" "	Honorius	395–423 A.D.	"	19.0	98
47	" "	Honorius	395–423 A.D.	"	18.7	97
48	" "	Valentinian III	425–455 A.D.	"	18.8	97
49	" "	Valentinian III	425–455 A.D.	"	18.7	97
50	" "	Julius Nepos	474–475 A.D.	Triens	17.8	92

As an example of the proper application of this method and its utility where other methods are not applicable, there are shown in Table VII results obtained by the writer on a group of 50 ancient gold coins. With one exception, these coins were all from the numismatic collection of the Princeton University Library, and the writer hereby acknowledges his indebtedness to Professor S. H. Weber, former Curator of Special Collections of that library, for his kindness in loaning these rare and valuable coins for the purpose of obtaining the results here recorded. The one exceptional coin, No. 2 in Table VII, was found during the excavation of the ancient Agora at Athens, Greece, and was examined by the writer at that site. The specific gravity of these coins was determined by the method of Archimedes, the coins being suspended from the arm of an analytical balance by means of a very fine platinum wire and weighed first in air and then in distilled water at 25°C. The gold content was found from the specific gravity by the use of the data now shown in Table VI.

From Table VII it will be seen that, with two exceptions, these coins were found to contain over 90% gold, and the great majority over 95% gold. Two coins, Nos. 5 and 6 in the table, were found by this method to contain only 56% and 55% gold, respectively, and in accordance with the previous discussion these two figures must be regarded as mere approximations that may be 5% or so from the truth. Nevertheless, these results are useful as showing the much lower fineness of these two coins as contrasted with all the others in this group. It is likely that all the other results are not more than 1% or 2% off from the true values. The fact that results on duplicate coins of the same ruler generally agree well with each other is an indication, at least, that the figures are essentially correct. An independent, though indirect and random, check on the essential correctness of the very high results for the gold content of the Roman coins is given by some figures published by Rauch (12) on the percentages of gold in a few Roman coins as obtained by fire assay. He reports that a coin of Nero contained 99.3% gold, which is close to the two results of 99% here obtained on coins of this same ruler. For a coin of Titus he gives 99.6% which is in fair agreement with the 99% found here. On a coin of Verus he gives 99.0% which agrees with the three results of 99% here obtained on coins of this emperor. It appears likely, therefore, that a considerable degree of confidence may be placed on the very high results shown in Table VII for the gold content of the Roman coins.

The uniformly very high gold content of the coins in the long series of Roman Imperial coins from Augustus to Diocletian, extending over a period of some three centuries, is remarkable. Since only occasional small specimens of native gold of such a high degree of fineness have been found in any part of the world, the occurrence of any ancient deposit of gold of this quality large enough to furnish directly the gold required for this extensive Roman coinage seems very improbable. It is much more probable that the gold which entered into these coins came from a number of different sources at different times, and that such gold was not only of a lower degree of fineness in general, but that it also differed considerably in gold content. The inescapable conclusion seems to be that the Romans knew and applied a highly efficient process for the purification of the native gold that entered into their coinage, and that they were also able consistently to produce purified metal of a very high degree of fineness. The slightly lower average gold content and the less uniform gold content of the Roman coins of the fourth and fifth centuries may be an indication of some loss in technical knowledge and skill, though this decrease in quality may be economic in origin. In general, these experimental results are of significance for the history of metallurgy as indicating the high degree of knowledge and skill in the metallurgy of gold extant in Roman times. The few similar high results for the gold content of the coins of ancient Persia and of Macedon may be an indication of the much earlier existence of a similar degree of metallurgical knowledge and skill.

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Mineral Nutrition of Plants and Animals

Frank A. Gilbert, University of Oklahoma Press, Norman. 1948. 131 pages; illustrated.

This small book sponsored by the American Petroleum Institute, and written by one of the botanists of the Battelle Memorial Institute of Columbus, possesses the virtues of brevity and forthrightness. It contains recent references to work in scattered experiments conducted in agricultural institutions over the country. It is of that handy size to be a ready reference book on the desk of a teacher or student, and also presents a bibliography of 329 entries. A suggested improvement is the addition of a discussion of the synthesis of amino acids in plants and the foundation of proteins in both plants and animals. This could be accomplished without much more than a few pages of text if presented in the style of the present text. Additional information on the trace elements would also add greatly to its value.—*A. E. Waller.*

A NEW NAME FOR A SPECIES OF SCAPHOIDEUS PREVIOUSLY PLACED UNDER THE NAME LUTEOLUS V. D.

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In 1894 Van Duzee[described a species of *Scaphoideus* which he named *luteolus*. Four specimens in the original series, one female and three males were from Anglesea, N. J. and New York City. Apparently two species were included in the original type series and no holotype was designated. The species was interpreted by the older Hemipterists, Van Duzee, Osborn and Ball, as the species treated by DeLong as *luteolus* in 1948.[2] In 1947 Oman[3] examined the leafhopper types in the Van Duzee collection at the Iowa State College and designated the only female of the series as the lectotype—the females of this group have no distinctive differential morphological characters. The male (*allotype*) is apparently another species. The specimen selected is representative of a species described by DeLong and Mohr as *baculus* in 1936. This leaves the species formerly known as *luteolus* without a name for which *Scaphoideus motus* is proposed.

Scaphoideus motus n. sp.

Resembling *immistus* in general form, but with basal two-thirds of elytra more uniformly brown and with distinct genital structures. Length 4–4.5 mm.

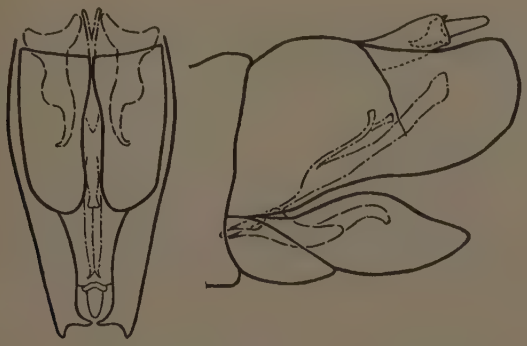

FIG. 1. Lateral and ventral views of the male genital structures of *Scaphoideus motus*.

Vertex bluntly produced, a little wider between the eyes at base than median length.

Color: Vertex white, marginal line heavy. The fuscous band between the eyes is broad, width almost half the length of vertex, medially produced. *Pronotum* almost uniformly brownish. Scutellum brownish fuscous anteriorly, paler posteriorly. *Elytra* brownish fuscous, veins brown, reflexed costal veinlets, apex of each elytron, and apical veins brownish; small white areolar spots just before and also posterior to cross nervures of apical cells.

[1]1894, Van Duzee, E. P. Buff. Soc. Nat. Sci. Bul. 5: 210.

[2]1948, DeLong, D. M. The Leafhoppers or Cicadellidae of Illinois. Nat. Hist. Surv. Div. 24: 97–376. June, 1948.

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Female seventh sternite roundedly produced, with a short V-shaped notch at apex. Male plates broadly rounded at apices. Aedeagus in lateral view broadened at one-third its length, somewhat narrowed at two-thirds its length, and again broadened to the enlarged apex, which is produced dorsally and bluntly pointed; dorsal process slender with two long slender bifurcate teeth. The pygofer is characterized by a small tooth on the apical caudal portion on each side.

Male *holotype* Hummelstown, Pa., July 6, 1919, J. N. Knull. Allotype female, New Haven, Conn., July 29, 1920, by W. B. Walden, and female paratypes from Clarkesville, Tenn., July 9, 1916, DeLong, and Reading, Pa., July 9, 1918, and male paratype from New Bremen, Ohio, July 18, 1927, DeLong. Male and female paratypes from Illinois in the Illinois Natural History Survey collection are from Alton, June 26, 1934; Ashley, Aug. 17, 1917; Cedar Lake (in bog), Aug. 6, 1906; Havana, July 2, 1934; Meredosia, Aug. 20, 1917; Monticello, June 11, 1934; Pana, July 21, 1937; Urbana (on cottonwood), July 12, 1920 and Aug. 11, 1932.

REVIEW OF LITERATURE ON FACTORS AFFECTING BOBWHITE QUAIL (COLINUS V. VIRGINIANUS) POPULATION FLUCTUATIONS[1]

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The cause of the present low in bobwhite quail populations in Ohio is a very controversial subject. Many reasons have been advanced to explain the periodic fluctuations that occur in bobwhite populations in this state. It is the purpose of this paper to discuss and attempt to evaluate these reasons. Of the many articles reviewed by this writer only a selected few have been used as references to avoid repetition and in order to eliminate unsound conclusions.

According to Leopold (1) the history of bobwhite populations in the north central states can be subdivided into four stages.

1. A pre-settlement stage during which it was likely that quail were restricted to the open edges of prairies and open woods.

2. A crude agricultural stage; a period where good interspersion of grain, brush, weeds and hedges made possible the extension of the birds' range and stabilized the population.

3. An intensified agricultural stage which was accompanied by a decrease in quail numbers "frequently due to overshooting, and nearly always due to a decrease in the area of habitable range."

4. A stage of agricultural depression, good roads, and automobiles.

Leopold mentions that the third stage began as early as 1875 in some regions and as late as 1905 in others. Severe fluctuations in bobwhite quail numbers in some areas were evident long before the third and fouth stages were firmly established (2, 3, 4, 5, 6, 7).

Various factors have been ascribed as the major causes of bobwhite population fluctuations—exposure, starvation, drought, predation, inbreeding, migrations, and competition. Reference to severe winters as a cause for the periodic reduction of quail is quite common in the literature (2, 4, 8, 9, 10, 11). Even as early as 1782 De Crevecoeur (8) reported a severe winter that reduced the bobwhite to near extinction in the East. Scott (12) states that:

> 1. Reasonably healthy Bobwhites may perish through imprisonment by drifting snow.
> 2. Exposure to cold, high winds and snow may kill reasonably healthy Bobwhites.

It is apparent that the phrase "reasonably healthy Bobwhites" may be applied to birds with avitaminoses of such a slight degree as to be vulnerable to climatic severities and yet not noticeable to the human eye. Leopold (4) also reports "fat well-fed quail as having died in numbers." Trautman's (13) investigations in Ohio indicate that:

[1]This paper was written while on a research fellowship granted by The Ohio Cooperative Wildlife Research Unit: The Ohio State University, The Ohio Division of Conservation and Natural Resources, The Fish and Wildlife Service and The Wildlife Management Institute cooperating. I am indebted to C. A. Dambach and D. L. Leedy for their helpful criticisms in the preparation of this paper.

1. An important factor in reducing the bobwhite breeding population in Ohio is the inability of the bird to obtain sufficient food during the stress periods of winter.

2. In every winter some mortality from starvation and exposure occurs.

3. High mortality among bobwhites occurs in freezing weather following severe sleet storms or during heavy snows.

4. The heaviest mortality occurs where clean farming is practiced and cover is deficient.

5. Mortality during very severe storms occurs even on farms where normally cover and food are abundant.

The destructiveness of winter weather is also emphasized by Allen (14) who states:

> It seems justifiable to conclude that snow and ice are the most destructive climatic agents to the bobwhite quail on the northern edge of its range. They operate either by cutting off the birds' food supply or by killing them directly when accompanied by strong winds and low temperatures. It is the exceptional years which kill the quail and it has been estimated that such a winter in the north central region can be expected every 4 to 7 years.

The ability of the bobwhite to withstand such environmental hardships as food shortages and exposure is very low as compared with other game species (the quail is classified as a song bird in Ohio), notably the ring-necked pheasant and wild turkey (15). Gerstell (15) stressed covey size as a factor in winter survivability. The bobwhite's ability to withstand lack of food was low as compared with that of other game birds (15). The results of fasting tests show that the maximum survival was less than one week even at high temperatures; at lower temperatures the survivability averaged only several days. In relation to the above Gerstell (15) states:

> In this connection it must be remembered that both observations in the field and tests performed in the laboratory have revealed the fact that even under favorable food conditions the bobwhite suffers mortality as a result of exposure to environmental extremes.

During the winter of 1935–36 on an area in Pennsylvania where winter feeding was carried on, high mortality occurred and over 90 per cent of the bobwhite perished (15). Nestler and Langenbach (16) state that extreme temperatures alone may not be the only cause of bobwhite mortality during severe winters. Their results showed that under controlled laboratory conditions no deaths of bobwhite quail occurred during sub-zero temperatures, whereas nearly all mortality during the experiments occurred during or immediately following abnormally heavy and prolonged rain-storms. Errington's (17) field observations apparently confirm these observations:

> Native northern bobwhites, if well fed and in prime condition, usually withstand most low temperatures occurring within their range. Many of my field notes deal with populations surviving air temperatures lower than 15° below zero (F.).

Drought in this region appears to be of minor significance in determining the general trend of bobwhite populations, although no definite proof is possessed. Errington (18) reports that if drought is extreme enough, it may cause a possible wholesale loss of eggs, partly because of egg spoilage after premature incubation and partly because of desertion.

The effect of cover on the carrying capacity of a quail range seems to be fairly well established (19). Cover may operate as the limiting factor during severe

fluctuations of bobwhite quail populations in some areas (13). It is entirely possible, too, that a lack of suitable cover may play a role in the effect of severe winters—a stepping stone to severity.

Predatory pressure has often been assigned first place as the explanation of lows in game populations. This is especially true at the present time in Ohio, due to the low number of game species and the high fox population (*Urocyon cinereoargenteus* and *Vulpes fulva*). Errington's (18) observations indicate that predation plays a major role in reducing populations only when the carrying capacity of the range is exceeded. Relatively high bobwhite populations have been maintained in sections of unglaciated Ohio, which also maintain a high fox population; in other sections, portions of glaciated Ohio, where there have been few or no foxes, the bobwhite have been relatively scarce.

Increased numbers of pheasants and Hungarian partridges may have affected the population of native bobwhites. Errington's (20) observations support this view. Although in northwestern Ohio an increase in pheasant populations occurred concurrently with a decline in bobwhite numbers and with a decrease in diversified farming of the land, there appears to be no clear relationship between the pheasant population and the severe decline in bobwhite numbers in that area.

The laymen in Ohio often express the belief that quail at the present time are smaller than in previous years and that this decrease in size and also in numbers is the result of inbreeding. Weight studies conducted by the author (unpublished) and by Trautman (21), on Ohio bobwhite show that the weight of quail in the state varies with locality and that the birds are as large in size in each locality as they were many years ago. Aldrich (22) mentions the possible effect of lowering survivability of native stock by inbreeding with introduced birds foreign to the region. The bobwhite quail in Ohio has been classified as a songbird since 1917. Very few releases of quail have been made since that time. Where releases have been studied they appear to have been unsuccessful (23). The small number of releases and the low survivability of released birds may eliminate the effect of inbreeding with foreign birds. Research by Nestler and Nelson (24) on inbreeding in pen-raised quail indicates:

> "that close inbreeding of quail can have deleterious effects on reproduction."

Relatively high quail populations in various sections of unglaciated Ohio and the occurrence of the "fall shuffle" tend to eliminate the effect of inbreeding in native populations. However, in areas of low populations as in portions of glaciated Ohio, a fall shuffle may not be effective in the prevention of inbreeding. (i.e. the coveys are so far apart that a mixing of coveys do not occur as a result of the fall shuffle). In a region of this type inbreeding over a period of time may therefore reduce reproduction and thus the total population.

The fact that birds of normal weight have been known to freeze despite reports (16, 17) of their tolerance to extremes of temperature under field and laboratory conditions indicates that death by freezing may be due to a change in the normal physiological condition of the birds. This change may be due to a dietary deficiency or the inability of this species to survive near the edge of its northern range. Nestler (25) suggests that a vitamin A deficiency may be a cause of the fluctuation in quail populations on their northern range. A study conducted by the author (26) indicated that a vitamin A deficiency during the winter of 1946–47 in Ohio was not a limiting factor in bobwhite quail populations.

It appears from the preceeding discussion that the cause of bobwhite quail population fluctuations in Ohio is unknown. These fluctuations are probably not due to any one factor but are the result of interactions of many factors.

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